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# III

# CHARACTER AND INTELLIGENCE

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EDWARD WEBB

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# CHARACTER

# AND

# INTELLIGENCE

AN ATTEMPT AT AN EXACT STUDY
OF CHARACTER

BEING A THESIS APPROVED FOR THE DEGREE OF
DOCTOR OF SCIENCE IN THE UNIVERSITY OF LONDON

by
EDWARD WEBB

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# PREFACE

THIS monograph constitutes the report of some research work conducted in the department of experimental psychology of University College, London, and originally formed a doctorate thesis on 'An Attempt at an Exact Study of Character,' presented to the University of London in July, 1914.

As far back as 1883 Francis Galton, in *Inquiries into Human Faculty and its Development*, wrote: "The subject of character deserves more statistical investigation than it has yet received, and none have a better chance of doing it than schoolmasters; their opportunities are indeed most enviable. It would be necessary to approach the subject wholly without prejudice, as a pure matter of observation, just as if the children were the flora and fauna of hitherto undiscovered species in an entirely new land." This task the writer has attempted,—the task of utilising the weapons of statistical methods to cut a path into what has been called 'a perfect jungle of psychological expressions of unknown (or little known) meaning.'

Prior to the reduction of many phenomena in the physical world to scientific law and the consequent material advantage to the human race, there have always been men ready to say: 'These things cannot be done; they are beyond the range of human ken.' When the laws are determined, so that man bridles the lightning to his service, and unlocks the energy of the mineral, the wonder and the mystery are still there; we can say of such a simple process as the burning of a candle what the poet says to the 'flower in the crannied wall':

> "but if I could understand
> What you are, root and all, and all in all,
> I should know what God and man is."

So of our study of character. The fact that the wonder and mystery must remain need not deter us from searching for the general laws underlying its action. Indeed, the promise of advantage to the human

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race, following their discovery, far transcends the material advantage that physical science has so richly gained.

I desire to express my deep gratitude to Professor Spearman; not only for his many valuable propositions in the theory of correlational methods for psychological use, but also for his inspiring guidance and constant encouragement throughout the research.

My thanks are also due to several members of the British Psychological Society, who, on my presenting an outline of the present report at two of its meetings, discussed the subject at some length, and thus the work was submitted to criticism from several standpoints. In Chapter VI, I have tried to meet all the points raised then and elsewhere.

I further desire to thank all those who have assisted me in the collection of my material—the teachers in the schools, the lecturers and prefects in the College, and others, who so cheerfully and faithfully performed the tasks assigned to them; as well as the Head Masters of the schools and the Principal of the College, for kindly allowing the work to be done.

Both Mr. Burt, who has edited this number, and myself, as author, desire to thank the Cambridge University Press for the extreme care and trouble, which, at a time of special difficulty, they have bestowed upon the production of this work.

E. WEBB.

*June*, 1915.

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# CHAPTER I

1. *Introductory.*
2. *Pre-scientific treatment of character.*
3. *Previous scientific investigations—Heymans and Wiersma; Pearson; Ach; Boyd Barrett; Stern.*
4. *Preliminary enquiry.*

## 1. Introductory.

The problem of character and of our estimation of it is unique in its frequent occurrence in practical life. We give or withhold our friendship as the result of such estimations; the choice of our teachers, clergy, civil servants, etc., is based, partly at least, upon some judgment of character; and business men choose their employees with some, perhaps specific, aspects of character in mind. For example, in choosing an errand-boy they would look more particularly for quickness and punctuality, in a book-keeper for trustworthiness and carefulness, in a manager for tact, originality and foresight.

The urgency of its practical application to all the business of life, as well as its wide psychological bearing, justifies an attempt at a systematic enquiry.

It is first necessary to consider the meanings attached to the word 'character.' A character in fiction emphasises one quality or group of qualities of the person concerned, the marked excess (or defect) in which, inevitably supplies the leverage which decides the crises of life. Thus, the ultimate catastrophe to himself and others is traceable to Hamlet's habitual irresolution and tendency to melancholy; Lear's tragic old age to his vacillation and waywardness; the failure of the 'noble' Brutus to his nobility. This is the key to much of the characterisation[1] of such writers as Meredith, Thomas Hardy, George Eliot. But only one man in many is a suitable subject for a novelist's characterisation; the many are what he would call 'average' persons,

[1] For an exhaustive treatment of the subject see Bradley, *Shakesperian Tragedies.*



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'colourless,' or even 'without character.' And yet these many make up the rank and file of life—they are the 'people' whose voice decides elections and on whose united labours rests the fabric of a nation. At every turn, these men must be met; their intelligence, goodwill, and reliability estimated, their value weighed. The novelist's method of making a character study is both useful and interesting; but a scientific survey of character, while including persons with very marked traits and characteristics, must also examine quite ordinary persons—the 'average' and the 'colourless'—as well.

It is a frequent practice in considering all that is meant by a 'total personality,' to classify the qualities involved into two broad categories, Intelligence and Character. Intelligence may be taken as including those qualities which are specially related to abilities in mental performances, while under Character it is usual to include the emotional and volitional—the social and moral qualities. If we guard against the assumption, unwarranted as yet, that Intelligence and Character are independent of each other, we shall find it convenient to adopt this two-fold conception of personality as a starting-point for our investigation. 'Character' is thus, for our purpose, the sum of all personal qualities which are not distinctly intellectual.

## 2. Pre-scientific treatment of character.

The subject of personal character has been frequently handled from two widely different points of view: first, abstract propositions have been put forward by theologians, teachers, and psychologists; secondly, concrete judgments have been made and acted upon by practical business men. Both are marked by dogma and theory far in excess of the evidence put forward in their support.

Among the former, many writers have issued classifications of the 'Temperaments[1].' They are remarkable for the frequency with which they reach the ancient and time-honoured four-fold classification of temperaments—sanguine, melancholy, choleric and phlegmatic. But the apparent unanimity is merely superficial. While adopting these terms to signify four types, they vary as widely as possible in the meanings they attach to them, and in the explanations offered. To cite only a few cases, early writers refer the differences to humours of the blood; Kant and others to vitality; Wundt, Külpe and others to

[1] For a collection of some of these see Stern, *Die differentielle Psychologie in ihren methodischen Grundlagen* (Appendix).

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the strength and speed of the emotions; Ach to certain aspects of the will.

It would be a profitless task to attempt to collect and systematise the mass of propositions put forward by these writers. Many of these propositions have received wide acceptation, partly because of the authority of the person stating them, and partly because of the frequency with which they are put forward. They pass from one generation to another; and, whether true or not, age gives them a certain weight which has no secure basis, for in this process the errors, equally with the truths, receive the cumulative support of successive advocates. The need must arise at some time that these propositions should be sifted by experimental enquiry, and either verified by scientific evidence or discarded.

But while theorists have speculated and dogmatised, another section of the community—the practical men of affairs—has had perforce to make some attack upon the problems involved in character. Some kind of estimation of a man's personal qualities must be made every day by business men, employers, committees, etc., and by all of us in appraising the desirability of persons to whom we are introduced. At this point it would be worth while to analyse, as far as possible, the basis upon which a business man makes such estimates when choosing a person for his employment.

(1) He knows what specific qualities are desirable for the office, and in addition to these specific qualities, he desires a good general character.

(2) He believes himself able to judge of the possession of these qualities in a personal interview—by irrelevant question and answer, perhaps—and by observing more particularly the candidate's manner and movements during the interview. A good judge of men relies very largely on this interview.

(3) He can, usually, obtain some more or less reliable 'references' to more or less reliable persons for testimony as to the previous behaviour of the candidate.

(4) He can, if he chooses, adopt some further test—such as a written examination—as a means of gauging some of the qualities.

This analysis of his position with regard to the task he has to perform, that of selecting the most desirable candidate, indicates the procedure which he almost invariably adopts, the only important modification being the committee plan of interview in which more than one person makes the estimations and their assessments are subsequently 'pooled'



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in some way. Appointments to large public bodies and business concerns are daily made on some such plan as the above. It is however common knowledge that even the selected candidates, in their confidential moments, will refer to the further element of their own good luck, implying thereby the inadequacy of the machinery of selection.

Speaking generally, the business man's judgments are vitiated by the lack of scientific investigation and knowledge. To enable him to judge character more effectively there is need of a scientific analysis of character, whether by types, constants, or otherwise; and it is the task of science to supply this. The making of such an analysis may lead us to the larger task of science, that of resolving the confusing complications of ordinary life to the lucid simplicity which science so often reveals, and this can only become possible if we collect our evidence in a scientific way, and abandon conclusions drawn from casual observations. We cannot hope to reach this lucid simplicity at a stride. But our investigation will serve its purpose if it effects (*a*) any approach to a reduction of the complications to scientific law, (*b*) some degree in which the methods employed become available for further work. (The excellence of judgment of a good judge of men dies with him; a scientific method once formulated, and a scientific truth once established, pass on to successive workers.)

### 3. Previous scientific investigations.

Systematic and scientific investigations, as distinguished from casual reminiscences and speculations, have not been numerous. The most notable are:

(1) G. Heymans, 1906. 'Über einige psychische Korrelationen,' *Zeitschrift für angewandte Psychologie.*

(2) G. Heymans and E. Wiersma, 1906–9. 'Beiträge zur speziellen Psychologie auf Grund einer Massenuntersuchung,' *Zeitschrift für Psychologie*, XLII–LI.

(3) Karl Pearson, 1906. 'On the Relationship of Intelligence to Size and Shape of Head, and to other Physical and Mental Characters,' *Biometrika*, V.

(4) N. Ach, 1910. *Über den Willensakt und das Temperament* (Leipzig).

(5) E. Boyd Barrett, 1911. *Motive Force and Motivation Tracks* (Longmans).

(6) W. Stern, 1911. *Die differentielle Psychologie in ihren methodischen Grundlagen* (Leipzig).

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(1) and (2) G. Heymans and E. Wiersma, whose work is much the most important for our present purpose, first adopted the 'biographic' method and sought to establish a classification of types of character from an analysis of the written lives of 110 leading men of art, science, literature, etc., of all times and countries. A second method was by means of a 'questionnaire' issued to all the doctors of the Pays-Bas—about 3000. This asked each doctor to choose a family well known to him and to answer questions with reference to the father, the mother, and the children respectively. They received 450 replies concerning 2523 persons in 458 families. The exhaustive list of questions, numbering 90, was framed with a view to establishing a classification of character-types, the dominant bases of the classification being (1) emotion, (2) activity, (3) proportion of primary to secondary function.

The work of these investigators has broken new ground in some important particulars. Their large range of questions aimed at a fairly complete diagnosis of each individual personality, and it was an advance in method to collect large masses of data, from judges working independently, in such a way as to afford conclusions by means of statistical methods. They modestly conclude a report of their work[1] with the remark 'Mais ces recherches ne sont qu'une première ébauche, pour laquelle la postérité n'aura certes qu'un sourire compatissant'; but we may hope that posterity, having smiled, will be able to build much useful work upon the foundations they have laid.

(3) Pearson's work deals (among other things) with estimates of general intelligence and some estimates of a few mental qualities (temper, popularity, self-consciousness, shyness, conscientiousness) and gives the correlation found to exist between these.

(4) N. Ach makes an attempt to classify temperaments, basing his classification upon experimental observations of the will. This work will be more fully referred to later (see Chap. V).

(5) E. Boyd Barrett, in his research in the psychology of Will, makes an experimental study of the choice process and seeks to deduce some conclusions on character, the essential elements of which are to be found in the 'will to act.'

(6) Wilhelm Stern gives a valuable schema for the experimental study of mental qualities by the investigation of individualities; he proposes the terms psychography, psychogram, etc., and distinguishes this from biography. In comparing his elaborate schema and its great

[1] In *L'Année Psychologique*, 1911. p. 79.

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aims with the amount of work done up to the present time he deplores the serious disparity.

(Further references to the literature of the subject will be found in Chap. V.)

### 4. Preliminary enquiry.

In the years 1909–1910, a preliminary enquiry by the present writer was made concerning the place of athletics with regard to some other aspects of college life, such as examination ability, general bodily fitness, and good character. The subjects were 104 men students in a training college for elementary teachers. Lists of these men in order of merit were obtained with reference to each of the four characteristics, as follows:

(*a*) *Athletics.* A committee of the captains of the various athletic clubs (cricket, tennis, swimming, association football, Rugby football) who were themselves students, was formed to assist me. A form of enquiry asking for particulars of previous experience in the pursuit of athletics, was filled up by each subject. (The captains knew of their pursuit of athletics during the years at college.) The committee examined these forms and, as a first step, divided them into five groups called A, B, C, D and E, group A being those most skilful in athletics and so on. They then took each group and decided an order of merit, and thus a complete list of the 104 men in order of merit was obtained.

(*b*) *Physique*, i.e. general bodily fitness. The visiting doctor placed the students in classes A, B, C, D and E, and a member of the college staff, very intimate with the sports, combined these with his own knowledge of the men to make an order of merit. The lecturer in physical exercises and hygiene independently made another list in order of merit. The criterion in both cases was 'soundness of bodily constitution,' and the judges were asked to avoid giving undue weight to mere muscular development.

(*c*) *Examinational ability.* The results of three college examinations (at the ends of the 1st, 3rd, and 5th terms respectively), which included all the subjects of the curriculum, gave three separate lists in order of merit.

(*d*) *Character.* Each of four college lecturers was asked to make a list of the men in order of merit with regard to general excellence of character.

(*Note.*—The judges in these four characteristics were in all cases quite unaware of the purpose for which their lists were required.)

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We can calculate the coefficients of correlation between A (athletics), P (physique), E (examination ability), and C (character) respectively, by the formula for 'ranks' (No. IV, Appendix I).

For P, E, and C we can, in addition, obtain the 'reliability-coefficients' by correlating the two estimates of P with each other (similarly for the three E's and the four C's). This enables us to correct the coefficients by means of Spearman's correction-formula (No. IX, Appendix I). The results yield the following table:

TABLE I.

| | Athletics | Physique | Examination ability | General excellence of character |
|---|---|---|---|---|
| Athletics | — | +·43 | −·04 | +·07 |
| | — | (·06) | (·08) | (·07) |
| Physique | +·43 | ·93. | +·09 | +·32 |
| | (·06) | — | (·07) | (·06) |
| Examination ability | −·04 | +·09 | ·91 | +·60 |
| | (·08) | (·07) | — | (·05) |
| General excellence of character | +·07 | +·32 | +·60 | ·62 |
| | (·07) | (·06) | (·05) | — |

Probable errors are placed in brackets. Reliabilities are shown in the diagonal spaces which would otherwise be empty and are in heavier type.

Conclusions from these results are of little value, and we may well suspend judgment until the more complete research is reported. Attention here should be given to the suspicious nature of the high correlation obtained between examination ability and general character (+ ·60), the estimates of the latter having been obtained from the college lecturers. This preliminary enquiry—though not even achieving its avowed object (that of determining the value and place of athletics in college life)—reveals itself as a method which *will* answer the question, and as being applicable to the much wider problem of seeking an analysis of character, as a whole, by collecting estimates of many fundamental qualities. Hence, the main enquiry which follows.

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# CHAPTER II

## THE MAIN ENQUIRY

1. *The experimental groups of subjects.*
2. *The choice of judges and their preparation for the work.*
3. *Lists of mental qualities used, and subsequent additional collection of data.*
4. *Method of marking adopted.*
5. *Further elaboration of the experimental tests of intelligence with second group of students.*

### 1. The experimental groups of subjects.

Investigation, whether psychical or physical, if it claims to have any general significance, must require that the particular cases placed under observation shall be, in certain respects at any rate, representative samples; only on this assumption can inferences drawn from consideration of these cases be applied to other cases in the community. Thus only as far as our sample of young men can be deemed representative will the truths deduced be applicable to other young men. The 'probable error' measures the degree of safety[1] with which this generalising can proceed; and since probable errors vary inversely as the number of individuals in the sample, a second requirement is that the number in the group shall be as large as is practically possible.

[1] The chances that a correlation coefficient ($r$) obtained from another 'random' sample will lie within the limits

$r \pm 1 \times (p.e.)$ are about even
$r \pm 2 \times (p.e.)$ „ 5·6 : 1
$r \pm 3 \times (p.e.)$ „ 23 : 1
etc.

See also Appendix I under 'Probable Error.'

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The subjects of this enquiry were:

I. 98 men students (average age, 21) at a training college, during the last six months of their second year of training (January to July 1912).

II. A similar group of 96 students during the similar period of the following year (January to July 1913).

III. Four groups of school-boys (average age, 12) in four different schools in London, numbering respectively 33, 35, 35, 37 (total 140).

It cannot be claimed that the young men of the training college approach to forming a random sample from all the young men in the British Isles. They are all, at entrance to the college, fairly well educated and to some extent 'selected.' But anyone who is at all familiar with training colleges will concede the point that they are fairly representative of a very large and important class of young men; still it will be wise, in drawing conclusions, to bear this limitation in mind. For the school-children it may be said that they represent an even wider class of twelve year old boys, for they were derived from four different schools widely separated from each other (two in north London, one in south, and one in south-west)—two were elementary schools under the control of the London County Council, one was an elementary school under the Hornsey Education Committee, and the fourth was a large secondary school with its own governing body.

## 2. THE CHOICE OF JUDGES AND THEIR PREPARATION FOR THE WORK.

To obtain reliability, and a measure of it, we require at least two judgments for each assessment. They should be made by judges working as independently as possible, both of each other and of any circumstances producing a common effect upon them, and they should be in a position to make observations of their subjects under conditions as free from restraint as possible. Some bias on their part will be avoided by conditions which require their assessments purely and solely for the sake of scientific research; they should know that their marks will have no actual effect upon the persons judged (for good or ill) and they should not know the use which will be made of their assessments. We can thus avoid many sources of bias. The subjects also should be available for observation under as wide a range of environment as possible—in the lecture-room, the common-room, the social gathering, the playing-fields, at home, during holidays, etc.; and they should be quite unaware that any such assessments are being made concerning

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them. A lecturer's knowledge of a student based on experience limited to the class-room is much circumscribed and liable to be very erroneous in many particulars.

Our preliminary enquiry (Chap. I, Section 4) reveals the probable bias that lecturers' judgments might attach to academical ability, and lecturers certainly have little opportunity of observation of the students except when they are under the restraining influences of college routine. At the college referred to 10 students of the second year are selected to act as *Prefects* for the year. They have the usual monitorial duties and are entrusted with considerable responsibility in matters of routine discipline and management of detail; they have also the full control of common-room and dining-room life. Their office is regarded in the college as a very honourable distinction, and the men chosen have always performed their duties well and won the respect of their fellow-students at the same time. These 10 prefects[1] (fellow-students of the subjects) were appointed as judges for the purposes of this research. They were arranged in pairs (avoiding putting two very like or very unlike temperaments together) and to each pair a group of 20 (or 19) students was assigned. This sharing-out of the subjects took place at a round-table discussion, the principles adopted being that the students assigned to each pair were as fully as possible and as equally as possible available to each of the pair for observation; and that no judge should accept as subject any student towards whom he had personally any specially strong feelings (either of friendship or the reverse). This took place in January (for each year) and the judges were instructed as follows:

*Instructions to the Prefects.*

"To prepare themselves during the term, by collecting evidence, to write a general character-sketch of each of their group during the Easter Holiday. (N.B.—No detailed instructions as to plan, headings, etc. were given: this preliminary task regards the individual as a whole.) To this end:

(1) To keep their subjects as closely under observation as possible.

(2) To keep a note-book with spaces for each subject and to enter facts and observations as they occur.

[1] As a member of the college staff, the author numbered among his duties (*a*) the general supervision of these affairs, (*b*) the office of Treasurer of the Students' Social and Athletic Union. These duties brought him more than a lecturer's usual share of personal and friendly intercourse with the prefects and other club officers—a relationship which (it was felt) made their co-operation in this research more thoroughly loyal and sustained.

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(3) To maintain strict secrecy—the students must not know that the enquiry is being made at all.

(4) To work strictly independently of the other prefects, and especially of the other prefect who is pairing with himself.

(5) To make their observations as *wide* as possible—ANY ability, habit, tendency or quality is worthy of notice."

The prefects entered into the spirit of the enquiry with much interest, and throughout the work each did his best for its success. They were, of course, bound to secrecy, and the author gave them a very definite pledge that he would treat everything they reported with the strictest confidence; as follows:

"On my part,

1. Whatever evidence I, as a member of the staff, am required to supply to the Principal, with reference to 'character' for the purpose of college reports, will be made and given in before I examine the sketches of the prefects; and any subsequent query to me concerning the character of anyone will be dealt with by me quite independently.

2. I shall regard everything written in the sketches as strictly confidential—you may feel perfectly assured that

(*a*) any adverse comments you may make will *never* be used against the individual,

(*b*) any good features noted will *never* be used to the advantage of the individual."

These judges thus had the Easter term to study the characters of their subjects in a quite general way (i.e. without any instructions as to what qualities are important, etc.) and also to develop their own thoughts on the subject. The sketches were all written during the Easter holiday, and are in the writer's possession; they are marked by completeness and candour beyond expectation.

In the following term schedules of qualities (see Chap. II, Sect. 3) were issued to them with instructions (see below) for marking their assessments. This is the analytical complement to the general character-sketches first obtained—our schedule of qualities aiming at an assessment of the individual in respect of every important personal quality.

In the schools no such unique choice of judges can be available. The schools were sought for and ultimately chosen as containing a normally constituted class of twelve year old boys who were well known to two class-masters, the latter being willing to undertake the work of

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judging[1]. The class-masters were asked first of all to make lists of the boys in order of merit based on 'General Excellence of Character' (this list furnishes No. 27 in the tables).

Subsequently they were supplied with schedules of qualities (see Chap. II, Sect. 3) with instructions (Chap. II, Sect. 4) for making their assessments. Additional judges, for special topics added as the work proceeded, were appointed with the same guiding principles (see under these topics below).

### 3. Lists of mental qualities adopted.

Under various circumstances many such blank lists of qualities have been drawn up. In some schools and institutions 'Personal Record Books' are used, in lunatic asylums there are clinical personality records, and in prisons there are criminal reports, all of which usually include some mental qualities[2].

The lists adopted in this work were made independently of these and were not (like the lists referred to in the footnote) casual collections of qualities, but were deduced on principle, and therefore—within the range contemplated—systematically complete. Qualities were included if they could be conceived as having a general and fundamental bearing upon the total personality, while other qualities which were obviously offshoots of these and dependent upon them were omitted. The lists (39 qualities for the students and 25 for the school-boys) are as follows. The headings given here (Emotions, etc.) were *not* given in the schedules issued to the judges, it being thought unwise to suggest to them in any way any relation between the qualities.

[1] Two class-masters, both of whom know the boys, are much to be preferred to one class-master and the Head Master. The Head Master draws his opinions of the boys largely from the class-master, and to some extent, vice versa. Two class-masters are much more likely to give judgments independently of each other. I tested this at two schools by asking the Head Master to refrain from discussing the matter with the two judges, and to himself supply an estimate under No. 27, i.e. a list in order of merit based on 'Character in General.' The reliability coefficients between the estimates of the two class-masters were ·52 at one school and ·55 at the other. These rose, however, to ·66 and ·72 and to ·77 and ·80 for the reliability between the respective class-masters and the Head Masters. (See also remarks by Professor Spearman, 'Correlation calculated from Faulty Data,' *Brit. Journ. Psychol.* III, 1910, 280.)

[2] For some examples see Rieger, *Methode der Intelligenzprüfung*, 1888; Sommer, *Lehrbuch der psychopathologischen Untersuchungs-Methoden*, 1899; Ziehen, *Liste*; British Association's *Report on Anthropometric Method*, 1909; Stern, *Die differentielle Psychologie in ihren methodischen Grundlagen*, 1911; also a suggested School Record Form drawn up by the Association of Assistant Masters, *School World*, March, 1913.

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LIST OF QUALITIES USED IN SCHEDULES FOR STUDENTS.

*Emotions.*

1. General tendency to be cheerful (as opposed to being depressed and low-spirited).
2. Tendency to *quick* oscillation between cheerfulness and depression (as opposed to permanence of mood).
3. Occasional liability to extreme depression.
4. Readiness to become angry.
5. Readiness to recover from anger.
6. Occasional liability to extreme anger.

*Self Qualities.*

9. Desire to excel at performances (whether of work, play, or otherwise) in which the person has his chief interest.
10. Desire to impose his own will on other people (as opposed to tolerance).
11. Eagerness for admiration.
12. Belief in his own powers.
13. Esteem of himself as a whole.
14. Offensive manifestation of this self-esteem (superciliousness).

*Sociality.*

15. Fondness for large social gatherings.
16. Fondness for small circle of intimate friends.
17. Impulsive kindness (to be distinguished from No. 18).
18. Tendency to do kindnesses on principle.
19. Degree of corporate spirit (in whatever body interest is taken, e.g. college, school, country, native place, etc.).
20. Trustworthiness (keeping his word or engagement, performing his believed duty).
21. Conscientiousness (keenness of interest in the goodness and wickedness of actions).
22. Interest in religious beliefs and ceremonies (regardless of denomination).
23. Readiness to accept the sentiments of his associates.
24. Desire to be liked by his associates.
25. Wideness of his influence (i.e. the extent to which he makes his influence felt among *any* of his fellows whenever he speaks or acts).
26. Intensity of his influence on his special intimates.
27. Degree of 'tact' in getting on with people.

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*Activity.*

28. Extent of mental work bestowed upon usual studies.
29. Extent of mental work bestowed upon pleasures (games, etc.).
30. Degree of bodily activity during business hours.
31. Degree of bodily activity in pursuit of pleasures (games, etc.).
32. Degree in which he works with distant objects in view (as opposed to living 'from hand to mouth').
33. Tendency *not* to abandon tasks in the face of obstacles.
34. Tendency *not* to abandon tasks from mere changeability.

*Intellect.*

35. Quickness of apprehension.
36. Profoundness of apprehension.
37. Soundness of common-sense.
38. Originality of ideas.

And, added subsequently:

7. Degree of aesthetic feeling (love of the beautiful for its own sake).
8. Degree of sense of humour.
47. Degree of strength of will.
48. Degree of excitability (as opposed to being phlegmatic).
39. Pure-mindedness (extent to which he shuns telling or hearing stories of immoral meaning).

LIST OF QUALITIES USED IN SCHEDULES FOR SCHOOL-BOYS.

*Emotions.*

1. General tendency to be cheerful (as opposed to being depressed and low-spirited.)
2. Readiness to become angry.
3. Readiness to recover from anger.
4. Readiness to show fear in the face of bodily danger.

*Self Qualities.*

5. Desire to excel at performances (whether of work, play or otherwise) in which the person has his chief interests.
6. Degree in which he makes his influence felt among the fellows.
7. Desire to impose his own will on others (as opposed to tolerance).
8. Eagerness for admiration.
9. Fondness for companionship, as opposed to solitariness.

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10. Tendency to show kindness.
11. Trustworthiness (keeping his word or engagement, performing his believed duty).
12. Conscientiousness (keenness of interest in the goodness and wickedness of actions).
13. Desire to be liked by his associates.

*Activity.*

14. Extent of mental work bestowed upon usual studies.
15. Extent of mental work bestowed upon pleasures (games, etc.).
16. Degree of bodily activity during school hours.
17. Degree of bodily activity in pursuit of pleasures (games, etc.).
18. Tendency *not* to abandon tasks in the face of obstacles.
19. Tendency *not* to abandon tasks from mere changeability.

*Intellect.*

20. Quickness of apprehension.
21. Profoundness of apprehension.
22. Soundness of common-sense.
23. Originality of ideas.

Added subsequently:

24. Physique (soundness of bodily constitution).
25. Skill in, and devotion to athletics.

As the work proceeded additions were made to these, as follows:

A. *Students.* (No. 28 *a*.) *Power of getting through mental work rapidly.* This was added at the suggestion of the prefects, who then definitely attached the idea of 'amount of work' to No. 28, and gave an assessment re doing this work *rapidly* as a separate item.

(No. 40.) *Physique.* One set of estimates was made by the visiting doctor, and another by the lecturer in physical exercises and hygiene. They were both asked to mark 'soundness of bodily constitution' and to avoid giving undue weight to mere muscular development.

(No. 44.) *Athletics.* One set of estimates was obtained as before (Chap. I, Section 4) from the captains; the other was made by a member of the college staff, much interested in the sports.

(No. 42.) *Estimate of general excellence of character.* Supplied by each prefect some weeks after handing in the main schedules.

(No. 41.) *Estimate of general excellence of character by lecturers.* Two members of the college staff made these.

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(No. 43.) *Examinational ability.* The students undergo three terminal examinations on the full general curriculum (at ends of 1st, 3rd, and 5th terms). The results of the first and third were pooled to give one set of values, and the second furnished the other.

(No. 45.) *Experimental tests of intelligence.* For the first group of students, and for the school-boys, two such tests were applied. They were:

(i) *Paired words of opposite meaning.* The subjects were supplied with lists of common words and were required to write the word of opposite meaning against each. The test was applied twice (with two weeks' interval) and at each test two lists of 24 words each were given. Time allowed for each set of 24 words—boys 40 seconds, men 30 seconds. A sample list of words is given:

| | | |
|---|---|---|
| bad | inside | slow |
| short | little | soft |
| black | dark | sad |
| true | poor | well |
| sorry | thick | full |
| peace | few | below |
| evening | slight | gay |
| brave | deep | mountain |

(ii) *Reconstructing disarranged sentences.* Papers with 12 disarranged sentences were supplied and subjects were required to write them in correct order. The test was applied twice (at intervals of two weeks) and at each test two sets of 12 sentences were used. Time allowed for each 12—boys 4 minutes, men 3 minutes. Sample of sentences:

1. raining it stopped has.
2. not is good writing your.
3. in girls playground the are the.
4. table the flowers are the withered on.
5. three all had boys the to-day right sums.
6. fog two aeroplanes collision into the during came.
7. gardens we wild can zoological see animals the in.
8. early one in day week close all must shops every.
9. the during weather seaside is at its very the hot pleasant.
10. into the an ship iceberg and crashed on soul every perished board.
11. is of health greatest men blessings enjoy the hope one to that can.
12. of kind him it very is trouble me take to for much so.

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B. *School-boys.* (No. 27.) *Teachers' estimate of general excellence of character.* This had been supplied previous to the issue to them of the schedules in detail.

(No. 26.) *'First impression' estimates of general excellence of character.* These were planned to test the degree in which character (in general) can be estimated at a single short personal interview. The judges were

*At School I.* Two 3rd year students from a neighbouring training college (who made the assessments at the request of the Head Master of the school and who have never been seen by the author).

*At School II.* The author and another member of the college staff.

*At School III.* The author and a lady who was unknown to the author and who did the work at the request of the Head Master.

*At School IV.* The author and another member of the college staff —not the same as for School II.

In each case the judges were instructed to have each boy separately for not more than a minute, and ask him any question he liked—not necessarily limited to school subjects—to observe his manner, movements, features, etc., and so try to form a judgment of his character. Having marked the boys A, B, C, D or E as a result of this interview, all those marked A were called out of the room together, and placed in an order of merit at a glance; and so on with the other groups. Of course, the purpose of the interview was scrupulously withheld from the boys—and the judges were all strangers to them.

(No. 28.) *Experimental tests of intelligence.* Described above under No. 45 for the students.

### 4. METHOD OF MARKING ADOPTED.

The following instructions were issued to all judges:

"(1) Personal qualities are named and briefly annotated in this schedule. If you have any doubt as to the meaning of any of them, please ask me[1].

[1] In October (i.e. about five months after all the schedules were returned) the judges were asked to give as exact an account as possible for *each* quality given of (*a*) what they understood by the given qualities and (*b*) what particulars guided them in marking their subjects. The returns for this were highly instructive—a summary of the most significant remarks is given in Appendix II. In general, they show (1) that the qualities named have a really definite and fairly common content in the minds of different judges, (2) that where there is any difference of view as to the meanings, these are the very judges whose assessments give insufficient reliability (see Chap. III, Section 2) and which were consequently rejected; e.g. the pair of judges for the fourth group of men differed considerably in their 'meanings' of the qualities—and we had to reject 20 for want of 'reliability' (see Chap. III, Section 2) out of their 40 assessments, as against 40 out of all the others numbering 360.



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(2) In the columns under each subject's name place one of the marks

$$+3,\ +2,\ +1,\ 0,\ -1,\ -2,\ -3$$

for each of the qualities specified. To avoid errors, please put the + signs as well as the −.

(3) The mark + 3 is for those showing a *very high* degree of the quality as compared with the average.

+ 2 is for those showing a degree of the quality distinctly above the average.

+ 1 is for those showing a degree of the quality slightly above the average.

0 is for those possessing the average degree of the quality for the group you are judging.

− 1 is for those slightly below the average.

− 2 is for those distinctly below the average.

− 3 is for those showing the lowest degree of the quality as compared with the average.

(4) As far as possible, in your group of 20 men, the number of subjects receiving above marks should be 1, 2, 4, 6, 4, 2, and 1 respectively[1]."

[1] For the other groups of subjects, the distribution suggested was

| | +3 | +2 | +1 | 0 | −1 | −2 | −3 |
|---|---|---|---|---|---|---|---|
| For 19 subjects | 1 | 2 | 4 | 5 | 4 | 2 | 1 |
| „ 33 „ | 2 | 4 | 6 | 9 | 6 | 4 | 2 |
| „ 35 „ | 2 | 4 | 6 | 11 | 6 | 4 | 2 |
| „ 37 „ | 2 | 4 | 7 | 11 | 7 | 4 | 2 |

*Frequency distribution.* If we consider a quality (e.g. conscientiousness) and enquire into its distribution among the general population, there is no ready answer to the question. For a million individuals there may be *one* only deserving the mark 'conscientiousness' in the highest degree; and *many* deserving it in the lowest degree (or, judging with more leniency, the numbers may be reversed). All depends upon our 'standard' of conscientiousness, which varies from one mind to another. The most apparent working basis for statistical method is the median degree of the quality in a large 'random sample' of individuals, and the use of this as our starting point or scale-zero. We thus obtain a scale moving by positive and negative grades on both sides of zero, and these considerations underlie our choice of such a scale. In order to determine what 'weight' should be assigned in the calculations to the varying grades estimated, certain assumptions appear necessary. To treat the abscissæ of any frequency distribution as measurable quantities implies the providing of each abscissa with a basis of measurement suitable for comparison with that of the measurements of the other abscissæ. But it is clear that the nature of the bases will determine the shape of the frequency curve. The most reasonable bases appear to be given by taking the seven classes as equidistant from one another. This

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The method of marking calls for a little examination. Fuller detail would be obtained if orders of merit for each quality could be made. But for many qualities judges are not capable of this, and it was felt that seven groups or classes was as much differentiation as was possible. Having adopted this, *all* the assessments were translated to this basis (even when, as e.g. in examinational ability, more detail is obviously possible). To test the validity of this translation, the correlations (for the whole year of 108 students) derived from the three general examinations were calculated:

(A) by using the complete order of merit and formula for 'ranks' (No. IV, Appendix I);

(B) by re-grading them in the seven classes as above and using the product-moment formula (No. III, Appendix I).

| | | | |
|---|---|---|---|
| The results by (A) are | ·83 | ·78 | ·77 |
| ,, ,, (B) ,, | ·82 | ·76 | ·76 |

The differences are very slight, and are (naturally) in the direction of reducing the figures. Hence, there appears to be no appreciable danger in adopting the seven-class plan of marking throughout.

## 5. FURTHER ELABORATION OF THE EXPERIMENTAL TESTS OF INTELLIGENCE WITH SECOND GROUP OF STUDENTS.

The present work was planned with the purpose of making a general analysis of the mental 'make-up' covering as wide a range of qualities as it seemed possible to adopt. Hitherto, the great bulk of experimental psychology has concerned itself with the distinctly *intellectual* performances; and in order to bring our own work into relation with this, it was felt desirable to utilise the second group of students,

has the effect of making the distribution approximately 'normal,' and corresponding to the following diagram.

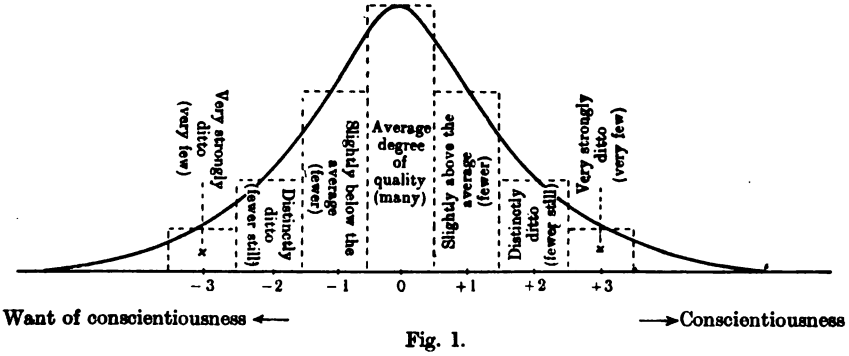


Fig. 1.



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and to impose a more complete series of experimental tests of intelligence upon them. In particular, it seemed advantageous to make the investigation centre upon the lately developed theory of a *General Factor of Intellectual Energy*. This very important proposition 'that all mental performances depend to a certain degree upon one and the same general common factor' provisionally termed 'General Ability' has been a prominent topic since it was first put forward by Spearman in 1904[1], corroborated by Krueger and Spearman in 1907, powerfully supported by the experimental work of Cyril Burt in 1909[2], S. Wyatt[3] and others, and placed beyond the region of doubt by Hart and Spearman in 1912[4]. The nature of the general common factor, in the last paper, is explained by conceiving that every performance depends partly upon some *common fund of energy* (physiologically the general energy of the whole cortex), and partly upon a factor specific to itself and to all very similar performances in proportion to their similarity (physiologically the specific activity of a particular system of cortical neurons also).

This explanation would demand not only that experimental tests involving 'simple' processes (sensory discrimination, motor, weight, memory, etc.) should yield results in agreement with this theory, but also tests devised to assess the 'higher' processes (such as generalising, judging, comparison) should do the same. It was also felt desirable to include a test of ability to react in a 'problematic situation'— a test specially devised in order to represent unquestionably 'common-sense' efficiency in every-day matters. Hence Test III. The following five tests were arranged as suitable to the subjects (96 young men about 21 years old).

Each of them was given twice: the sections marked A of each test on one day, and those marked B a week later.

### *Test I. Reasoning.*

A. State whether the following conclusions are necessarily true or not. If not, point out the error:

(1) If Parr's pills are of any value, those who take them will improve in health. My friend who has been taking them has improved in health, therefore they are of value.

[1] *Amer. J. Psychol.* XV. 1904, 'General Intelligence Objectively Measured and Determined'; and (Krueger and Spearman) *Zeitschrift f. Psych.* 1907, XLIV 69, 'Die Korrelation zw. verschiedenen geistigen Leistungs-Fähigkeiten.'

[2] *B.J.P.* III. 1909 (Burt), 'Experimental Tests of General Intelligence.'

[3] *B.J.P.* VI. 1913 (Wyatt), 'The Quantitative Investigation of Higher Mental Processes.'

[4] *B.J.P.* V. 1912 (Hart and Spearman), 'General Ability, its Existence and Nature.'

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(2) Nothing that increases taxation can long be popular. All wars increase taxation, and consequently none of them can be popular very long.

(3) He must have stolen the goods. Else why did he hide them, as no thief fails to do?

B. State whether the following conclusions are necessarily true or not. If not, point out the error:

(1) Giving advice is useless. For either you advise a man what he means to do, in which case the advice is unnecessary; or you advise him what he does not mean to do, and the advice is ineffectual.

(2) The object of war is durable peace; therefore soldiers are the best peace-makers.

(3) Night must be the cause of day, for it invariably precedes it.

Time allowed for each section—10 minutes.

*Test II. Comparison.*

A. What differences are there between gambling and legitimate business investment?

B. What are the chief points of (*a*) similarity, (*b*) difference between motor-cars and sailing-ships?

Time allowed for each section—10 minutes.

*Test III. Problematic situations.*

A. Imagine the following situation:

You and a young lady friend have taken a return day trip by steamer from a small coast town *A* to another small coast town *B* on a fine summer day. You spend the day pleasantly at *B*, but lose the only return boat which starts back at 6.30 p.m. The only train connection from *B* to *A* is by a long loop line via *C* thus:

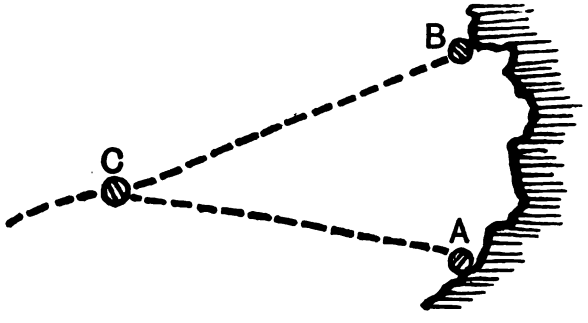


Fig. 2.

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and if you took the train from *B* to *C* you would be too late to catch the last train from *C* to *A*. You are expected back at *A* by the young lady's mother, whom you are anxious to propitiate. She is nervous, and has a rather strict sense of propriety. The distance by road is about 15 miles. You do not know anybody in *B*. You are not very well-to-do, but have about £2 in your pocket.

You are required to state *concisely*

(1) what are the alternative plans of procedure which you could adopt under these circumstances,

(2) which of these plans you would actually choose,

and (3) the reasons for your choice.

B. Imagine the following situation:

You are one of a party of 16 persons visiting a large town in Germany, under the direction of a 'guide.' You have never been in the town before and you cannot speak any German. You arrive late at night, walk in a party from the railway station to the hotel, and at once go to bed—the 'guide' having arranged all details. You sleep in a room by yourself. You rise early next morning and go for a stroll by yourself before breakfast. You wander aimlessly for about an hour and in trying to retrace your steps you lose your way. You have had no occasion to learn either the name of the hotel or its address.

You are required to state *concisely*

(1) what are the alternative plans of procedure which you could adopt under these circumstances,

(2) which of these plans you would actually choose,

and (3) the reasons for your choice.

Time allowed for each section—15 minutes.

*Test IV. Definitions.*

A. Define the following things:

house, tree, slipper, road.

B. Define the following things:

garden, chair, door, song.

Time allowed for each section—10 minutes.

*Test V. Paired opposites.*

This test was included to relate the results of the tests with this group of students to those of the former group (with whom only the two simple tests described on p. 16 were used). The two parts (A and B) were exactly similar in all respects.

Time allowed for each set of 24 words—30 seconds.

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# CHAPTER III

## THE MATHEMATICAL TREATMENT OF THE DATA

1. *On statistical methods.*
2. *The estimates—their 'reliability.'*
3. *Correlations between the estimates.*
4. *The experimental tests of intelligence—marking and results.*
5. *Correlations of the correlations.*

### 1. On statistical methods.

We have thus collected a large mass of judgments or estimates, and other data for examination.

The present work is guided by the principle that neither casual observation nor dialectical discussion can furnish the groundwork of any empirical science, the decision between the conflicting opinions of descriptive psychologists must rest with definite, and as a rule, quantitative evidence. This alone gives one the firm position of being able to say 'For the given data and under the given conditions the following statements are true. You are bound either to believe them, or having collected similar data under similar conditions, to substantiate your disbelief.'

On the other hand, it is necessary to use the utmost precaution in the methods of calculation. Dr Myers, at the L.C.C. Teachers' Conference 1912, gave the advice 'Beware of an average.' Another psychologist, to whom this was quoted, retorted 'Yes, but distrust totally anything which is not an average.' Between the two mentors it certainly behoves us to be wary. The 'man in the street' is convinced that 'statistics will prove anything,' and in perhaps a larger degree than in any other respect the ignorance of audiences has been exploited by false interpretations of statistics. The simple reason is that statistics is a science, and therefore can no more be rationally handled without a special training than can (say) physics or chemistry. But while

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'statistics' may be put forward in a misleading and erroneous manner, the *mathematics of statistics* is no less trustworthy than any other mathematics[1].

That section of mathematics known as the Theory of Probability, with specialised portions developed from it for special problems, has evolved valuable propositions safeguarding the wary from erroneous interpretations of such a mass of figures as that with which we have to deal. These propositions have had far-reaching uses in physical science and in actuarial work; they have in recent years been applied to some biological and social problems (at the instance of Francis Galton and later of Karl Pearson, Udny Yule and others), and still more recently they have been adapted and applied to psychological problems by Professor Spearman and others. Spearman's position seems to be one of antagonism to pedantic nicety of the mathematical form at the expense of a superficial consideration of the concrete material; the outstanding features of his work are the insistent demand for a measure of the 'reliability' (for the special meaning of this term, see next section) of any series of measurements, and for a calculation—if not perfect, at any rate as approximate as our present means will allow—of the probable effect of the unreliability on the results.

The most important of these propositions and all of them which are relevant to the present work are given in Appendix I (with references, etc.) to which readers are referred for fuller details and proofs. This will serve not only the purpose of protecting the non-mathematical reader from them as far as possible, but also as a protest against what appears to be a danger in some recent psychological research—that of losing sight of the psychology in the discussion of the mathematical weapons employed. We must, of course, examine our methods with great strictness, but our main concern is with the psychological interpretation of the results they furnish.

### 2. The estimates—their reliability.

For our work we have (*a*) 10 groups of students numbering 19 or 20 in each group (total 194), (*b*) 4 groups of school-boys numbering respectively 33, 35, 35 and 37 (total 140). We possess two estimates for each quality.

[1] The distinction between 'statistics' and 'the mathematics of statistics' is of far-reaching importance. Failure to realise it leads to confusion and error in unnumbered instances, among them debates in the High Court of Parliament, departmental reports upon which legislation is based, the caustic disagreements 'even among doctors,' and the misrepresentations of cheap journalism.

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We shall keep the two sets of data separate. There are presumably radical differences—with respect to some of the qualities—between boys of 12 and young men of 21; our results, if kept separate, will show not only if this is true but will also reveal the nature of these differences.

The extent to which the two estimates of each quality agree with each other represents the degree of 'reliability' that can be placed upon the particular pair of judgments. If, for instance, Judge A understood from the title of a certain quality something different from Judge B, or if the quality, though understood similarly, were incapable of being judged accurately, the estimates would present little or no agreement. But if the agreement rises above a minimum, there is evidence, as far as it goes, that the judges are correspondingly capable of making the assessment, and that their data will be of use to us. The degree of this 'reliability' is measured by the coefficient of correlation—calculated by the product-moment formula (No. III, Appendix I) between the two sets of estimates (in each quality by each pair of judges). These reliability coefficients are entered in Table II (men) and Table III (boys)[1].

TABLE II. *Reliability Coefficients* (students).

| No. | 10 pairs of 'judges' | | | | | | | | | | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ·54 | ·62 | ·85 | ·66 | ·55 | ·57 | — | ·71 | ·48 | — | ·62 |
| 2 | ·40 | ·43 | ·29 | — | ·59 | ·41 | ·53 | ·69 | ·50 | — | ·48 |
| 3 | — | ·31 | ·57 | — | ·43 | ·50 | — | ·36 | ·60 | — | ·46 |
| 4 | ·54 | — | ·52 | — | ·57 | ·53 | ·62 | ·50 | — | — | ·55 |
| 5 | ·73 | ·40 | ·66 | ·43 | ·55 | — | ·69 | ·50 | ·41 | — | ·55 |
| 6 | ·61 | ·39 | ·33 | — | ·57 | — | ·48 | ·45 | ·64 | — | ·49 |
| 7 | ·50 | ·52 | ·64 | ·47 | ·36 | ·50 | ·60 | ·64 | ·57 | ·33 | ·51 |
| 8 | ·67 | ·31 | ·69 | ·52 | ·55 | ·50 | — | ·53 | ·73 | — | ·56 |
| 9 | ·50 | ·31 | ·45 | — | ·59 | ·53 | ·57 | ·66 | ·57 | — | ·52 |
| 10 | ·66 | — | ·76 | — | ·79 | ·53 | ·46 | ·45 | ·67 | — | ·62 |
| 11 | ·50 | ·57 | — | ·38 | ·64 | ·69 | ·57 | ·71 | ·64 | ·33 | ·56 |
| 12 | ·83 | ·45 | ·45 | — | ·69 | ·76 | ·66 | ·43 | ·62 | ·36 | ·58 |
| 13 | ·76 | ·29 | ·59 | ·43 | ·36 | ·80 | ·73 | ·60 | ·43 | ·41 | ·54 |
| 14 | ·66 | ·36 | ·50 | ·38 | ·64 | ·55 | ·44 | ·50 | ·53 | — | ·51 |
| 15 | ·38 | ·29 | ·42 | ·50 | ·38 | ·60 | ·55 | ·69 | ·60 | ·67 | ·51 |
| 16 | ·38 | ·33 | ·54 | — | ·52 | — | ·48 | ·48 | ·60 | — | ·48 |
| 17 | ·52 | — | ·52 | — | ·38 | ·36 | — | ·55 | ·62 | — | ·49 |
| 18 | ·57 | ·45 | ·54 | — | ·59 | ·60 | ·58 | ·58 | ·60 | — | ·56 |
| 19 | ·40 | — | ·69 | — | ·47 | ·60 | ·76 | ·50 | ·55 | — | ·57 |
| 20 | ·38 | ·40 | ·59 | — | ·64 | ·73 | ·48 | ·53 | ·57 | ·48 | ·53 |
| 21 | ·64 | ·40 | ·66 | — | ·64 | ·48 | ·69 | ·65 | ·71 | ·41 | ·59 |
| 22 | ·61 | ·74 | ·52 | — | ·43 | ·40 | ·38 | ·76 | ·67 | ·46 | ·55 |
| 23 | ·31 | ·48 | — | ·57 | — | ·34 | ·43 | — | ·60 | — | ·46 |

[1] The gaps in Tables II and III indicate low reliabilities which were entirely rejected.

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TABLE II (*continued*).

| No. | 10 pairs of 'judges' | | | | | | | | | | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 24 | ·39 | ·48 | ·42 | ·33 | ·40 | ·48 | ·78 | ·76 | ·53 | ·57 | ·51 |
| 25 | ·40 | ·74 | ·38 | — | ·40 | ·60 | ·57 | ·62 | ·60 | — | ·54 |
| 26 | ·33 | ·66 | ·30 | ·28 | ·47 | ·40 | ·57 | ·71 | ·67 | — | ·49 |
| 27 | ·45 | ·55 | — | — | — | ·55 | ·43 | — | ·64 | — | ·52 |
| 28 | ·80 | ·59 | ·33 | — | ·76 | ·34 | ·34 | ·53 | ·67 | ·43 | ·53 |
| 29 | ·45 | ·79 | ·76 | ·66 | ·52 | ·69 | ·74 | ·55 | ·48 | ·48 | ·61 |
| 30 | ·50 | ·70 | ·26 | ·28 | — | ·48 | ·53 | ·43 | ·60 | ·57 | ·48 |
| 31 | ·45 | ·62 | ·64 | ·92 | ·38 | ·71 | ·60 | ·71 | ·50 | ·41 | ·59 |
| 32 | ·66 | ·71 | ·33 | — | ·43 | ·40 | ·57 | ·60 | ·64 | ·46 | ·53 |
| 33 | ·48 | ·52 | ·47 | — | ·55 | ·58 | ·40 | ·58 | — | ·36 | ·49 |
| 34 | ·39 | ·76 | ·34 | — | ·36 | ·36 | ·45 | ·71 | ·78 | — | ·52 |
| 35 | ·50 | ·57 | ·59 | ·43 | ·57 | ·38 | ·48 | ·58 | ·60 | ·39 | ·51 |
| 36 | ·47 | ·66 | ·69 | ·59 | ·36 | ·53 | ·64 | ·50 | ·62 | ·50 | ·56 |
| 37 | ·45 | ·59 | ·50 | ·24 | ·43 | ·45 | ·74 | ·40 | ·50 | ·50 | ·48 |
| 38 | ·38 | ·31 | ·62 | ·43 | ·43 | ·50 | ·74 | ·60 | ·67 | ·60 | ·53 |
| 39 | ·57 | — | ·59 | ·69 | ·97 | ·71 | ·57 | ·48 | ·60 | ·53 | ·63 |
| 40 | ·67 | ·55 | ·62 | ·57 | ·67 | ·83 | ·70 | ·90 | ·74 | ·81 | ·71 |
| 41 | ·83 | ·64 | ·55 | ·71 | ·73 | ·46 | ·38 | ·50 | ·50 | — | ·59 |
| 42 | ·76 | ·52 | ·90 | ·76 | ·79 | ·64 | ·60 | ·62 | ·62 | ·62 | ·68 |
| 43 | ·77 | ·80 | ·64 | ·56 | ·71 | ·74 | ·71 | ·71 | ·69 | ·67 | ·70 |
| 44 | ·69 | ·64 | ·69 | ·43 | ·38 | ·73 | ·92 | ·83 | ·43 | ·76 | ·65 |
| 45 | — | — | — | — | — | ·80 | ·59 | ·61 | ·64 | ·59 | ·64 |
| 47 | — | ·45 | ·48 | ·50 | — | ·53 | — | — | — | ·53 | ·50 |
| 480 | — | ·43 | ·69 | — | — | ·64 | — | — | — | ·74 | ·63 |

TABLE III. *Reliability coefficients* (boys).

| No. of Quality in Schedule | 1st School | 2nd School | 3rd School | 4th School | Average | No. of Quality in Schedule | 1st School | 2nd School | 3rd School | 4th School | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ·49 | ·47 | ·64 | — | ·53 | 15 | ·79 | ·59 | ·87 | — | ·75 |
| 2 | ·46 | ·52 | ·62 | ·38 | ·50 | 16 | ·37 | ·65 | ·36 | ·41 | ·45 |
| 3 | ·50 | ·54 | ·69 | — | ·58 | 17 | ·59 | ·72 | ·74 | ·46 | ·63 |
| 4 | ·37 | ·46 | — | — | ·42 | 18 | ·77 | ·52 | ·59 | — | ·63 |
| 5 | ·76 | ·50 | ·48 | ·44 | ·55 | 19 | ·40 | ·43 | — | ·34 | ·39 |
| 6 | ·56 | ·69 | — | ·30 | ·48 | 20 | ·62 | ·63 | ·38 | ·47 | ·52 |
| 7 | — | ·69 | ·65 | ·56 | ·63 | 21 | ·65 | ·67 | ·42 | ·30 | ·51 |
| 8 | ·42 | ·55 | ·44 | ·29 | ·47 | 22 | ·73 | ·79 | ·64 | ·36 | ·63 |
| 9 | — | ·57 | ·54 | ·55 | ·55 | 23 | ·61 | ·57 | ·54 | — | ·57 |
| 10 | ·43 | ·41 | ·67 | ·35 | ·47 | 24 | ·61 | ·54 | ·69 | — | ·61 |
| 11 | ·43 | ·52 | ·59 | ·57 | ·53 | 25 | ·46 | ·81 | ·88 | — | ·72 |
| 12 | ·52 | ·49 | ·62 | ·62 | ·56 | 26 | ·53 | ·55 | ·64 | ·31 | ·51 |
| 13 | ·36 | ·41 | ·37 | ·46 | ·40 | 27 | ·52 | ·80 | ·63 | ·55 | ·63 |
| 14 | ·71 | ·79 | ·75 | ·39 | ·66 | 28 | ·43 | — | ·57 | — | ·50 |

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| 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
|---|---|---|---|---|---|---|---|---|
| ·52 | +·48 | +·47 | +·57 | +·31 | +·30 | +·31 | +·26 | +·20 |

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All the estimates which fell below a minimum (to be described in the next section) were entirely rejected[1]. The average reliability of those retained for both boys and men was ·55. That this is low is to be accounted for by the care taken to obtain the two estimates made as independently as possible; that it is as high as ·55 was sufficient warrant to proceed with the mathematical evaluation of the data[2].

### 3. CORRELATIONS BETWEEN THE ESTIMATES.

The two judgments for each quality (wherever their reliability attains the minimum chosen) are now 'pooled' and the correlation of the pool for each quality with each other quality determined. This is determined by the product-moment formula (No. III, Appendix I). This furnishes Tables IV (students) and V (boys) by averaging the coefficients for the same quality for all the groups. The probable errors of these coefficients are determined by Formula VII, Appendix I, and are given in these tables.

But these coefficients are subject to the errors revealed by the reliability coefficients. Our coefficients (above) are calculated from the pool of *two* measurements (or estimates) of any quality *a* with a similar pool of *two* measurements for any other quality *b*. They must therefore be corrected for attenuation due to their imperfect reliability.

This is done by Spearman's correction formula (No. IX, Appendix I) which gives the correlation which would exist between the pool of an *infinite* number of measurements of *a* and that of an *infinite* number of measurements of *b*, which are similar, in the sense of having the same average correlation with *a* and also with one another. It should be remembered that this formula is rigidly correct—it makes no assumptions whatever beyond 'those of mathematics and logic'; that it enables us to deal with 'the pool of an infinite number of measurements' in place of our small number of actual measurements—a condition which every person who has to make any kind of measurement might desire; and that the coefficient calculated from the pool of an infinite number of

[1] With the boys 15 pairs of estimates out of a total of 112 pairs, were thus rejected; with the students 63 out of 445. It is to be noted that the students were given a longer list of qualities. The average reliability for *all* the estimates (i.e. including those rejected) was: boys, ·49, students, ·47.

[2] On the question of the reliability of estimates, see also H. Waite (*Biometrika*, July, 1911, 'The Teacher's Estimations of the General Intelligence of School-children'), who found that paired judgments by two different masters gave reliabilities of ·47 and ·50 (for 1405 and 2018 pairs of judgments respectively). He also found the reliability of pairs of judgments made by the *same* master at intervals of nine months, to be ·66.

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measurements is accurate when the two observers are independent of one another; it is too *small* when the errors of the two observers are correlated positively with each other, and too *large* when they are correlated inversely. As the last case appears out of the question in the present investigation, there is no fear here of over, but rather of under-estimation of correlation[1].

The correction-factor

$$\sqrt{\frac{1+r_1}{2r_1} \cdot \frac{1+r_2}{2r_2}}$$

is obviously 1 when both $r_1$ and $r_2$ are 1, i.e. if both the reliabilities are perfect. It is obviously more than 1 in all other cases (see Appendix I); the formula for the probable error shows that there is a limit below which the correction-formula ceases to be of any practical use[2].

We must therefore choose a minimum reliability. That chosen in this work is such a minimum as will cause the correction-factor never to exceed 1·8. This admits reliabilities down to about ·31 (if paired with another reliability which is higher) or about ·36 if paired with a similar low one[3].

The crude coefficients obtained as above were thus corrected, and those for each quality, having been averaged as before, are given in Table VI (men) and Table VII (boys). The average correction-factor for both men and boys was 1·41. The probable errors of the corrected coefficients are equal respectively to those of Tables IV and V increased in the same proportion as the coefficients themselves are increased.

### 4. The experimental tests of intelligence.

The methods of marking, with the results, must first be described.

[1] *Zeitschrift für angewandte Psychologie*, VI. 1912, Spearman, 'Der Beobachtungsfehler in der Korrelationslehre.'

[2] The corrected value can only exceed 1 in the case when the two measurements of the same thing correlate more with the other thing than with one another. This is, of course, irrational, unless the excess is reasonably attributable to mere sampling error.

[3] This minimum was determined by drawing up the set of coefficients in the form of tables, admitting

| | | | | |
|---|---|---|---|---|
| 1st | only | those | reliabilities | >·60 |
| 2nd | ,, | ,, | ,, | >·55 |
| 3rd | ,, | ,, | ,, | >·50 |
| 4th | ,, | ,, | ,, | >·45 |
| 5th | ,, | ,, | ,, | >·40 and so on. |

The results were averaged, and the table using ·35 or more showed less deviation from the general mean than the others—this gives us the optimum course.

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| | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | + ·26 | + ·34 | + ·58 | − ·25 | + ·49 | + ·37 | − ·01 | + ·24 | + ·11 | + ·49 | + ·34 | + ·08 | + ·53 | 1 |
| 8 | − ·48 | − ·51 | − ·36 | − ·33 | − ·20 | − ·12 | − ·46 | − ·59 | − ·30 | + ·29 | − ·39 | − ·48 | + ·57 | 2 |
| 3 | − ·17 | − ·40 | − ·48 | + ·12 | − ·39 | − ·20 | − ·17 | − ·25 | − ·12 | − ·17 | − ·31 | − ·17 | − ·34 | 3 |
| 1 | − ·39 | − ·53 | − ·09 | − ·65 | + ·04 | + ·34 | − ·44 | − ·77 | + ·07 | + ·30 | ·00 | − ·04 | + ·65 | 4 |
| 1 | + ·24 | + ·48 | + ·18 | + ·32 | + ·24 | + ·03 | + ·25 | + ·55 | + ·07 | + ·09 | + ·09 | + ·09 | + ·14 | 5 |
| 6 | − ·18 | − ·30 | + ·14 | − ·47 | + ·18 | + ·18 | − ·17 | − ·45 | + ·06 | + ·22 | − ·01 | − ·14 | + ·48 | 6 |
| 5 | + ·71 | + ·76 | + ·64 | + ·59 | + ·42 | − ·17 | + ·65 | + ·81 | + ·46 | − ·15 | + ·46 | + ·42 | − ·36 | 7 |
| 5 | + ·49 | + ·45 | + ·79 | − ·42 | + ·44 | + ·17 | − ·04 | + ·27 | + ·18 | + ·30 | − ·17 | + ·36 | + ·18 | 8 |
| 2 | + ·63 | + ·61 | + ·54 | + ·31 | + ·48 | + ·11 | + ·39 | + ·57 | + ·62 | + ·19 | + ·39 | + ·22 | + ·35 | 9 |
| 0 | − ·13 | − ·25 | − ·05 | − ·46 | + ·18 | + ·40 | − ·18 | − ·56 | + ·08 | + ·30 | + ·13 | + ·34 | + ·85 | 10 |
| 0 | − ·29 | − ·37 | − ·07 | − ·41 | + ·10 | + ·24 | − ·32 | − ·49 | + ·17 | + ·27 | + ·10 | − ·30 | + ·77 | 11 |
| 8 | + ·27 | + ·16 | + ·36 | − ·28 | + ·58 | + ·29 | + ·10 | − ·13 | + ·46 | + ·12 | + ·35 | + ·40 | + ·37 | 12 |
| 7 | − ·05 | − ·20 | + ·27 | − ·45 | + ·40 | + ·17 | − ·17 | − ·38 | + ·25 | + ·07 | + ·11 | − ·04 | + ·49 | 13 |
| 0 | − ·28 | − ·49 | + ·13 | − ·69 | + ·16 | + ·28 | − ·37 | − ·73 | + ·07 | + ·23 | + ·22 | − ·34 | + ·75 | 14 |
| 2 | − ·16 | − ·12 | + ·44 | − ·67 | + ·53 | + ·35 | − ·26 | − ·15 | − ·08 | + ·50 | + ·30 | − ·14 | + ·82 | 15 |
| 2 | + ·64 | + ·55 | + ·31 | + ·51 | + ·45 | − ·21 | + ·41 | + ·52 | + ·33 | + ·01 | + ·35 | + ·28 | − ·85 | 16 |
| 1 | + ·19 | + ·37 | + ·30 | + ·31 | − ·04 | − ·10 | + ·02 | + ·27 | − ·19 | + ·19 | − ·07 | − ·20 | + ·38 | 17 |
| 5 | + ·69 | + ·79 | + ·47 | + ·66 | + ·32 | − ·07 | + ·57 | + ·98 | + ·17 | − ·01 | + ·23 | + ·36 | − ·52 | 18 |
| 0 | + ·32 | + ·38 | + ·45 | + ·06 | + ·28 | + ·35 | + ·08 | + ·39 | + ·03 | + ·58 | + ·21 | + ·40 | + ·31 | 19 |
| 0 | + ·66 | + ·57 | + ·46 | + ·82 | + ·18 | − ·09 | + ·70 | + 1·04 | + ·31 | − ·05 | + ·28 | + ·55 | − ·50 | 20 |
| 4 | + ·66 | + ·64 | + ·43 | + ·94 | + ·22 | − ·17 | + ·68 | + ·90 | + ·19 | − ·25 | + ·22 | + ·62 | − ·40 | 21 |
| 3 | + ·54 | + ·52 | + ·18 | + ·93 | + ·09 | − ·21 | + ·64 | + ·71 | + ·28 | − ·35 | + ·22 | + ·41 | − ·52 | 22 |
| 2 | − ·09 | + ·10 | − ·30 | + ·42 | − ·09 | − ·42 | + ·24 | + ·26 | − ·04 | − ·13 | + ·02 | + ·27 | − ·36 | 23 |
| 3 | + ·13 | + ·02 | + ·20 | − ·25 | + ·16 | + ·19 | + ·03 | + ·25 | + ·07 | + ·44 | + ·07 | − ·08 | + ·50 | 24 |
| 5 | + ·77 | + ·69 | + ·70 | + ·15 | + ·53 | + ·23 | + ·29 | + ·63 | + ·21 | + ·40 | + ·11 | + ·59 | − ·25 | 25 |
| 7 | + ·88 | + ·74 | + ·86 | + ·09 | + ·65 | + ·17 | + ·22 | + ·60 | + ·35 | + ·22 | + ·39 | + ·65 | − ·37 | 26 |
| 0 | + ·32 | + ·35 | + ·45 | + ·23 | + ·32 | − ·05 | + ·30 | + ·66 | ·00 | + ·08 | − ·02 | + ·32 | − ·58 | 27 |
| 0 | + ·74 | + ·67 | + ·40 | + ·65 | + ·59 | + ·06 | + ·75 | + ·65 | + ·78 | − ·18 | + ·60 | + ·45 | − ·09 | 28 |
| 7 | + ·01 | + ·02 | + ·11 | − ·40 | + ·26 | + ·50 | − ·17 | − ·01 | − ·16 | + ·94 | − ·15 | + ·24 | + ·64 | 29 |
| 4 | + ·34 | + ·21 | + ·54 | − ·15 | + ·32 | + ·27 | ·00 | + ·14 | + ·19 | + ·36 | + ·13 | + ·30 | + ·42 | 30 |
| 7 | + ·02 | − ·04 | + ·17 | − ·52 | + ·25 | + ·50 | − ·27 | − ·03 | − ·16 | + ·92 | − ·19 | + ·12 | + ·64 | 31 |
| 7 | + ·75 | + ·67 | + ·36 | + ·73 | + ·44 | − ·05 | + ·69 | + ·68 | + ·59 | − ·20 | + ·45 | + ·76 | − ·31 | 32 |
| 0 | + ·72 | + ·77 | + ·69 | + ·45 | + ·60 | + ·11 | + ·38 | + ·55 | + ·41 | − ·03 | + ·28 | + ·76 | − ·19 | 33 |
| 0 | + ·71 | + ·73 | + ·48 | + ·64 | + ·39 | − ·05 | + ·57 | + ·74 | + ·39 | − ·18 | + ·34 | + ·78 | − ·69 | 34 |
| | + ·96 | + ·81 | + 1·04 | + ·11 | + ·96 | + ·15 | + ·15 | + ·50 | + ·25 | + ·27 | + ·53 | + ·61 | + ·23 | 35 |
| 5 | | + 1·00 | + ·88 | + ·47 | + ·84 | + ·01 | + ·62 | + ·77 | + ·65 | ·00 | + ·56 | + ·75 | − ·29 | 36 |
| 1 | + 1·00 | | + ·84 | + ·54 | + ·70 | + ·04 | + ·53 | + ·88 | + ·52 | + ·10 | + ·29 | + ·95 | − ·47 | 37 |
| 4 | + ·88 | + ·84 | | + ·15 | + ·94 | + ·17 | + ·26 | + ·55 | + ·57 | + ·19 | + ·47 | + ·69 | − ·09 | 38 |
| 1 | + ·47 | + ·54 | + ·15 | | ·00 | − ·24 | + ·69 | + ·71 | + ·24 | − ·31 | + ·15 | + ·38 | − ·53 | 39 |
| 5 | + ·84 | + ·70 | + ·94 | ·00 | | + ·17 | + ·27 | + ·43 | + ·81 | + ·17 | + ·54 | + ·59 | − ·05 | 40 |
| 5 | + ·01 | + ·04 | + ·17 | − ·24 | + ·17 | | + ·09 | − ·01 | + ·09 | + ·74 | − ·07 | + ·17 | + ·29 | 41 |
| 5 | + ·62 | + ·53 | + ·26 | + ·69 | + ·27 | + ·09 | | + ·69 | + ·60 | − ·06 | + ·37 | + ·41 | − ·07 | 42 |
| 0 | + ·77 | + ·88 | + ·55 | + ·71 | + ·43 | − ·01 | + ·69 | | + ·43 | + ·06 | + ·36 | + ·67 | − ·27 | 43 |
| 5 | + ·65 | + ·52 | + ·57 | + ·24 | + ·81 | + ·09 | + ·60 | + ·43 | | − ·03 | + ·67 | + ·58 | − ·10 | 44 |
| 7 | ·00 | + ·10 | + ·19 | − ·31 | + ·17 | + ·74 | − ·06 | + ·06 | − ·03 | | − ·17 | + ·34 | + ·24 | 45 |
| 3 | + ·56 | + ·29 | + ·47 | + ·15 | + ·54 | − ·07 | + ·37 | + ·36 | + ·67 | − ·17 | | + ·29 | + ·23 | 46 |
| | + ·75 | + ·95 | + ·69 | + ·38 | + ·59 | + ·17 | + ·41 | + ·67 | + ·58 | + ·34 | + ·29 | | − ·51 | 47 |
| 3 | − ·29 | − ·47 | − ·09 | − ·58 | − ·05 | + ·29 | − ·07 | − ·27 | − ·10 | + ·24 | + ·23 | − ·51 | | 48 |
| | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | |

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| 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | |
|---|---|---|---|---|---|---|---|---|---|---|
| 03 | + 69 | + ·74 | + ·68 | + ·83 | + ·42 | + ·39 | +·43 | +·45 | +·30 | 1 |
| 87 | + 01 | −·24 | − ·42 | + ·20 | + ·47 | + ·35 | −·21 | −·29 | +·02 | 2 |
| 54 | − 23 | + ·36 | + ·37 | + ·10 | − ·11 | − ·06 | +·19 | +·50 | −·06 | 3 |
| 36 | − 43 | − ·19 | − ·12 | − ·26 | −1·10 | − ·90 | −·17 | −·20 | +·26 | 4 |
| 19 | + 95 | +1·05 | +1·00 | + ·81 | + ·16 | + ·21 | +·79 | +·82 | +·51 | 5 |
| 12 | + 75 | + ·83 | + ·80 | + ·77 | + ·63 | + ·58 | +·85 | +·77 | +·34 | 6 |
| 14 | + 38 | − ·07 | − ·13 | + ·36 | + ·74 | + ·75 | +·07 | −·03 | +·25 | 7 |
| 19 | + ·43 | + ·13 | + ·13 | + ·65 | + ·56 | + ·53 | +·59 | +·22 | +·49 | 8 |
| 9 | + ·57 | + ·54 | + ·56 | + ·61 | + ·54 | + ·75 | +·43 | +·42 | +·58 | 9 |
| 5 | + ·29 | + ·52 | + ·69 | + ·10 | − ·39 | − ·31 | +·61 | +·68 | −·13 | 10 |
| | + ·41 | + ·71 | + ·81 | + ·32 | − ·32 | − ·39 | +·58 | +·83 | +·08 | 11 |
| | + ·47 | + ·75 | + ·84 | + ·32 | − ·47 | − ·41 | +·61 | +·70 | +·27 | 12 |
| | + ·39 | + ·28 | + ·23 | + ·77 | + ·33 | + ·53 | +·39 | +·41 | +·26 | 13 |
| | + ·95 | +1·07 | +1·02 | + ·75 | − ·20 | − ·13 | +·72 | +·79 | +·44 | 14 |
| | + ·27 | + ·21 | + ·24 | + ·49 | + ·65 | + ·92 | +·22 | +·27 | +·26 | 15 |
| | + ·66 | + ·38 | + ·44 | + ·95 | + ·52 | + ·57 | +·40 | +·22 | +·57 | 16 |
| | + ·26 | + ·04 | + ·21 | + ·42 | + ·78 | +1·03 | +·09 | +·15 | +·26 | 17 |
| | +1·05 | +1·11 | + ·97 | + ·76 | − ·15 | − ·12 | +·52 | +·69 | +·45 | 18 |
| | + ·15 | + ·38 | + ·51 | − ·11 | − ·29 | − ·27 | +·23 | +·42 | +·10 | 19 |
| | — | +1·14 | +1·06 | +1·08 | + ·03 | + 0·9 | +·79 | +·82 | +·60 | 20 |
| | +1·14 | — | +1·11 | + ·99 | + ·02 | + ·02 | +·77 | +·94 | +·57 | 21 |
| | +1·06 | +1·11 | — | + ·89 | − ·07 | + ·02 | +·77 | +·88 | +·46 | 22 |
| | +1·08 | + ·99 | + ·89 | — | + ·05 | + ·22 | +·69 | +·59 | +·46 | 23 |
| | + ·03 | + ·02 | − ·07 | + ·05 | — | + ·81 | +·05 | −·04 | +·04 | 24 |
| | + ·09 | + ·02 | + ·02 | + ·22 | + ·81 | — | +·07 | −·03 | +·27 | 25 |
| | + ·79 | + ·77 | + ·77 | + ·69 | + ·05 | + ·07 | — | +·88 | +·35 | 26 |
| | + ·82 | + ·94 | + ·88 | + ·59 | − ·04 | − ·03 | +·88 | — | +·28 | 27 |
| | + ·60 | + ·57 | + ·46 | + ·46 | + ·04 | + ·27 | +·35 | +·28 | — | 28 |
| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | |

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### *Test I. Reasoning*[1].

A maximum mark of 10 was assumed for each of the three sections of each test, and the papers were marked on this basis. The value of the answers was estimated much in the same way as teachers estimate the excellence of an answer in history, geography, etc. Credit was given for partially correct answers or for differing answers—the aim being to assess intelligent thinking as shown by the papers. Particulars of the marking are given in the following table:

TABLE VIII.

| | No. in group | Reliability between the two tests | Test A: Av. marks per individual | Test A: $\sigma$ | Test B: Av. marks per individual | Test B: $\sigma$ |
|---|---|---|---|---|---|---|
| Group (1) | 19 | ·70 | 13·4 | 4·6 | 14·1 | 3·9 |
| „ (2) | 19 | ·46 | 14·1 | 3·9 | 14·2 | 3·0 |
| „ (3) | 19 | ·76 | 14·6 | 4·4 | 13·8 | 3·2 |
| „ (4) | 19 | ·66 | 14·6 | 3·2 | 14·9 | 3·9 |
| „ (5) | 20 | ·64 | 12·9 | 4·0 | 14·1 | 3·1 |
| For whole group | 96 | ·65 | 13·9 | 4·0 | 14·2 | 3·5 |

### *Test II. Comparison.*

A maximum of 30 marks was adopted for each test (A and B) and the value of the answers sent in was again estimated as to the extent to which they revealed intelligent thinking. The following table gives the particulars:

TABLE IX.

| | No. in group | Reliability between the two tests | Test A: Av. marks per individual | Test A: $\sigma$ | Test B: Av. marks per individual | Test B: $\sigma$ |
|---|---|---|---|---|---|---|
| Group (1) | 19 | ·83 | 14·6 | 3·5 | 14·6 | 3·4 |
| „ (2) | 19 | ·80 | 15·9 | 2·0 | 14·9 | 2·3 |
| „ (3) | 19 | ·88 | 14·9 | 3·9 | 14·9 | 3·7 |
| „ (4) | 19 | ·80 | 14·6 | 3·9 | 15·8 | 3·7 |
| „ (5) | 20 | ·65 | 15·9 | 3·2 | 15·6 | 2·7 |
| For whole group | 96 | ·79 | 15·1 | 3·4 | 15·1 | 3·1 |

### *Test III. Problematic situations.*

A maximum of 20 marks was adopted for these two tests. The subjects had been instructed (*a*) to state as many solutions to the difficult situation as they could imagine, (*b*) to make a choice and to

[1] Parts of this test, and of No. II, were taken from tests described by A. Peterson, *Psych. Rev.* xv. 1908—the others are new.

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justify this—and the papers were marked definitely in accordance with the manner and extent in which these instructions were carried out. The results are:

TABLE X.

| | No. in group | Reliability between the two tests | Test A: Av. marks per individual | Test A: $\sigma$ | Test B: Av. marks per individual | Test B: $\sigma$ |
|---|---|---|---|---|---|---|
| Group (1) | 19 | ·72 | 11·6 | 3·4 | 11·4 | 3·2 |
| „ (2) | 19 | ·65 | 12·6 | 2·8 | 11·6 | 2·0 |
| „ (3) | 19 | ·79 | 10·6 | 2·6 | 11·6 | 2·4 |
| „ (4) | 19 | ·65 | 11·6 | 2·7 | 12·1 | 3·2 |
| „ (5) | 20 | ·72 | 10·2 | 2·1 | 12·1 | 2·2 |
| For whole group | 96 | ·71 | 11·3 | 2·7 | 11·7 | 2·6 |

*Test IV. Definitions.*

These answers were marked on the basis of a maximum of 10—credit being given for imperfect definitions wherever *essential* qualities of the things were referred to. The results are:

TABLE XI.

| | No. in group | Reliability between the two tests | Test A: Av. marks per individual | Test A: $\sigma$ | Test B: Av. marks per individual | Test B: $\sigma$ |
|---|---|---|---|---|---|---|
| Group (1) | 19 | ·65 | 5·5 | 1·5 | 6·1 | 1·6 |
| „ (2) | 19 | ·90 | 5·7 | 1·3 | 5·7 | 1·2 |
| „ (3) | 19 | ·55 | 5·9 | 1·9 | 6·3 | 1·8 |
| „ (4) | 19 | ·74 | 5·9 | 1·8 | 6·1 | 1·7 |
| „ (5) | 20 | ·60 | 6·4 | 1·5 | 6·0 | 1·3 |
| For whole group | 96 | ·69 | 5·8 | 1·6 | 6·0 | 1·5 |

*Test V. Paired opposites.*

One mark was allowed for each correct word. Any word which could reasonably be regarded as 'opposite' in meaning to the given word was accepted, e.g. 'son' and 'mother' both occurred as opposites to 'father.' The time allowed had been decided by previous trial so that no subject could finish (the largest mark was 46 out of the possible 48). The results are:

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TABLE XII.

| | No. in group | Reliability between the two tests | Test A: Av. marks per individual | Test A: $\sigma$ | Test B: Av. marks per individual | Test B: $\sigma$ |
|---|---|---|---|---|---|---|
| Group (1) | 19 | ·80 | 36·0 | 3·8 | 35·9 | 5·1 |
| „ (2) | 19 | ·65 | 35·4 | 4·3 | 34·1 | 5·4 |
| „ (3) | 19 | ·88 | 34·4 | 4·2 | 34·7 | 4·4 |
| „ (4) | 19 | ·88 | 36·2 | 2·8 | 34·5 | 2·8 |
| „ (5) | 20 | ·83 | 33·3 | 6·1 | 34·0 | 5·0 |
| For whole group | 96 | ·81 | 35·1 | 4·2 | 34·6 | 4·5 |

The corrected coefficients of correlation were obtained in a precisely similar manner to our former procedure; the marks for each test were regraded into our seven-fold scale (3, 2, 1, 0, − 1, − 2, − 3) and the results of the two parts of each test were pooled—thus making this portion of our data usable with the rest. The coefficients were calculated as before by the product-moment formula[1] (No. III) and then corrected by Spearman's correction formula (No. IX).

## 5. Correlations of the correlations.

A further procedure has now to be described. Table VI for the men and Table VII for the boys give the correlation coefficients of each set of estimates with every other set for the same subjects. We have, for instance, in the boys' table (VII) the following columns of coefficients for 'profoundness of apprehension' (No. 21) with 'originality of ideas' (No. 23).

| No. of quality in schedule | Profoundness of apprehension (21) | Originality of ideas (23) |
|---|---|---|
| 1 | + ·74 | + ·83 |
| 2 | − ·24 | + ·20 |
| 3 | + ·36 | + ·10 |
| 4 | − ·19 | − ·26 |
| 5 | +1·05 | + ·81 |
| 6 | + ·83 | + ·77 |
| 7 | − ·07 | + ·36 |
| 8 | + ·13 | + ·65 |
| 9 | + ·54 | + ·61 |
| 10 | + ·52 | + ·10 |
| 11 | + ·71 | + ·32 |
| 12 | + ·75 | + ·32 |
| 13 | + ·28 | + ·77 |
| 14 | +1·07 | + ·75 |
| 15 | + ·21 | + ·49 |
| 16 | + ·38 | + ·95 |
| 17 | + ·04 | + ·42 |

[1] See Appendix I, note to par. 3, also par. 6.

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| No. of quality in schedule | Profoundness of apprehension (21) | Originality of ideas (23) |
|---|---|---|
| 18 | +1·11 | + ·76 |
| 19 | + ·38 | − ·11 |
| 20 | +1·14 | +1·08 |
| 21 | — | + ·99 |
| 22 | +1·11 | + ·89 |
| 23 | + ·99 | — |
| 24 | + ·02 | + ·05 |
| 25 | + ·02 | + ·22 |
| 26 | + ·77 | + ·69 |
| 27 | + ·94 | + ·59 |
| 28 | + ·57 | + ·46 |
| Average | + ·54 | + ·52 |

Each of these coefficients represents the extent to which high (or low) degrees of these qualities tend to be accompanied by high (or low) degrees of each other quality in the list. But quite obviously these two columns are themselves series of numerical values assigned to the two qualities, and the correlation between these is a further source of information to us. This coefficient represents not so much the extent to which two qualities tend to occur in the same individuals as the extent to which they may be regarded as possessing, or not possessing, the same common elements from among the other qualities, and the same errors in the estimates thereof. Thus the coefficient of + ·99 between 'profoundness of apprehension' and 'originality of ideas,' in becoming + ·73 by this new method of calculation—the correlation of the correlations—reveals the fact that the two qualities, in the minds of the judges, have many elements in common, and some, though few, not common. It is interesting to note that this conception of regarding correlation as being due to 'common elements' is the starting point of Bravais' work—the fountain-head of the mathematics of correlation[1]. But in the present case we are in the advantageous position of possessing some information as to what the 'common elements' are. If 'profoundness' and 'originality of ideas' were exactly similar in nature we should expect that the correlation of their correlations would be + 1; it is therefore easy to examine the columns and see which of the values are most responsible for producing the discrepancy[2] (in this case between + ·73 and unity). We thus have a means of analysing the 'build' of

[1] Bravais, *Analyse Mathématique sur les Probabilités des Erreurs de Situation d'un Point*, 1846; see also J. C. Kapteyn, *Monthly Notices of the Roy. Astron. Soc.* 72 (6), 1912.

[2] In the case of correlations, $x = ky$, $\therefore$ discrepancy $\propto x - ky$, and this equals

$$(X - \bar{X}) - k(Y - \bar{Y})$$

and here $k$ = (approx.) 1.

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a quality in terms of the other qualities. The discrepancies between the two coefficients for each quality are a close indication of those qualities which tend either to produce or reduce correlation between the columns, the large discrepancies, of course, being those which reduce. Disregarding discrepancies less than ·20 we have the following significant lists:

(1) 'Profoundness' correlates more than 'originality of ideas' with:

| | | Discrepancy |
|---|---|---|
| No. 3. | Recovery from anger | ·24 |
| „ 5. | Desire to excel | ·22 |
| „ 10. | Kindness | ·40 |
| „ 11. | Trustworthiness | ·37 |
| „ 12. | Conscientiousness | ·41 |
| „ 14. | Mental work in usual studies | ·30 |
| „ 18. | Perseverance | ·33 |
| „ 19. | Absence of changeability | ·47 |
| „ 22. | Common-sense | ·20 |

(2) 'Originality of ideas' correlates more than 'profoundness' with:

| | | Discrepancy |
|---|---|---|
| No. 2. | Anger | ·46 |
| „ 7. | Intolerance | ·45 |
| „ 8. | Eagerness for admiration | ·28 |
| „ 13. | Desire to be liked | ·51 |
| „ 15. | Mental work bestowed on pleasures | ·30 |
| „ 16. | Bodily activity (school) | ·59 |
| „ 17. | Bodily activity (pleasures) | ·40 |
| „ 25. | Athletics | ·22 |

(This example is given in this chapter mainly to illustrate the treatment of the data. The topics involved will be more fully discussed later.)

In the hope that this new application of $R_{ab}$ (see page 36), which we shall call the 'correlations of the correlations,' will thus throw much light upon the 'build' of some of the qualities and of the estimates of them, they have been calculated for all the items in the table for the boys (Table XIV) and for the following for the men: Nos. 1, 9, 10, 12, 15, 21, 28, 31, 32, 33, 35, 36, 37, 38, 45, 46 (Table XIII).

It is to be noted that it makes very little difference whether we use, for this purpose, the raw coefficients of Tables IV and V, or the corrected Tables VI and VII. Actually we have used the latter[1].

[1] See Chap. VI for an examination of the actual difference.



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TABLE XIII. *Correlations of the correlations* (men).

| | 1 | 9 | 10 | 12 | 15 | 21 | 28 | 31 | 32 | 33 | 35 | 36 | 37 | 38 | 45 | 46 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | — | +·08 | +·21 | +·16 | +·66 | −·20 | −·28 | +·69 | −·27 | +·21 | +·65 | +·18 | +·19 | +·53 | +·63 | −·01 | 1 |
| 9 | +·08 | — | 0 | +·34 | −·15 | +·41 | +·62 | −·12 | +·59 | +·57 | +·49 | +·65 | +·56 | +·58 | −·21 | +·66 | 9 |
| 10 | +·21 | 0 | — | +·78 | +·75 | −·89 | −·58 | +·72 | −·64 | −·50 | −·10 | −·53 | −·61 | −·21 | +·68 | −·20 | 10 |
| 12 | +·16 | +·34 | +·78 | — | +·45 | −·59 | −·10 | +·36 | −·19 | −·09 | +·13 | −·09 | −·23 | +·12 | +·32 | +·32 | 12 |
| 15 | +·66 | −·15 | +·75 | +·45 | — | −·75 | −·69 | +·90 | −·86 | −·38 | +·20 | −·39 | −·43 | +·02 | +·89 | −·34 | 15 |
| 21 | −·20 | +·41 | −·89 | −·59 | −·75 | — | +·80 | −·69 | +·88 | +·73 | +·28 | +·75 | +·81 | +·41 | −·69 | +·41 | 21 |
| 28 | −·28 | +·62 | −·58 | −·10 | −·69 | +·80 | — | −·72 | +·93 | +·71 | +·29 | +·76 | +·73 | +·48 | −·77 | +·74 | 28 |
| 31 | +·69 | −·12 | +·72 | +·36 | +·90 | −·69 | −·72 | — | −·69 | −·30 | +·20 | −·33 | −·39 | −·02 | +·96 | −·34 | 31 |
| 32 | −·27 | +·59 | −·64 | −·19 | −·86 | +·88 | +·93 | −·69 | — | +·80 | +·29 | +·80 | +·81 | +·51 | −·76 | +·66 | 32 |
| 33 | +·21 | +·57 | −·50 | −·09 | −·38 | +·73 | +·71 | −·30 | +·80 | — | +·67 | +·92 | +·90 | +·79 | −·37 | +·55 | 33 |
| 35 | +·65 | +·49 | −·10 | +·13 | +·20 | +·28 | +·29 | +·20 | +·29 | +·67 | — | +·73 | +·69 | +·91 | +·12 | +·46 | 35 |
| 36 | +·18 | +·65 | −·53 | −·09 | −·39 | +·75 | +·76 | −·33 | +·80 | +·92 | +·73 | — | +·94 | +·84 | −·40 | +·67 | 36 |
| 37 | +·19 | +·56 | −·61 | −·23 | −·43 | +·81 | +·73 | −·39 | +·81 | +·90 | +·69 | +·94 | — | +·81 | −·39 | +·58 | 37 |
| 38 | +·53 | +·58 | −·21 | +·12 | +·02 | +·41 | +·48 | −·02 | +·51 | +·79 | +·91 | +·84 | +·81 | — | −·07 | +·57 | 38 |
| 45 | +·63 | −·21 | +·68 | +·32 | +·89 | −·69 | −·77 | +·96 | −·76 | −·37 | +·12 | −·40 | −·39 | −·07 | — | −·49 | 45 |
| 46 | −·01 | +·66 | −·20 | +·32 | −·34 | +·41 | +·74 | −·34 | +·66 | +·55 | +·46 | +·67 | +·58 | +·57 | −·49 | — | 46 |
| | 1 | 9 | 10 | 12 | 15 | 21 | 28 | 31 | 32 | 33 | 35 | 36 | 37 | 38 | 45 | 46 | |

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TABLE XIII. *Correlations of the correlations* (men).

| 1 | 9 | 10 | 12 | 15 | 21 | 28 | 31 | 32 | 33 | 35 | 36 | 37 | 38 | 45 | 46 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

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# CHAPTER IV

## THE GENERAL FACTOR OF INTELLECTIVE ENERGY

1. *Introductory.*
2. *Examination of results for evidence of a general factor of intellective energy.*
3. *'Saturation' of the coefficients by 'g' (the general factor).*
4. *Obtaining the coefficients between the experimentally measured 'g' and the various estimates.*
5. *Theory as to the nature of 'g.'*
6. *An attempt to examine the nature of 'g' in the light of its correlations.*
7. *The estimates of intelligence-qualities compared with the experimentally measured 'g.' The nature of 'estimates' of intelligence examined.*

### 1. Introductory.

We are now in a position to examine the results and attempt to interpret their significance; and to compare these interpretations with the results of other experimental work and with 'opinions' which are commonly held on these subjects.

With such a wide field of enquiry and such a large mass of results, it is neither possible nor desirable that all the conclusions in detail should be derived and discussed in one book—our aim in this is to draw the main conclusions and to examine certain prominent psychological problems in the light of them. We shall deal first with the intellectual side.

### 2. Examination of results for evidence of a general factor of intellective energy.

The inter-correlations of our five experimental tests of intelligence, with their probable errors, are given in Table XV.



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TABLE XV.

| | Reasoning | Comparison | Problematic situations | Definitions | Paired opposites |
|---|---|---|---|---|---|
| Reasoning | — | ·73 | ·58 | ·50 | ·37 |
| | — | (·031) | (·045) | (·051) | (·058) |
| Comparison | ·73 | — | ·59 | ·43 | ·30 |
| | (·031) | — | (·044) | (·055) | (·061) |
| Problematic situations | ·58 | ·59 | — | ·25 | ·32 |
| | (·045) | (·044) | — | (·063) | (·060) |
| Definitions | ·50 | ·43 | ·25 | — | ·10 |
| | (·051) | (·055) | (·063) | — | (·067) |
| Paired opposites | ·37 | ·30 | ·32 | ·10 | — |
| | (·058) | (·061) | (·060) | (·067) | — |

Using the method adopted by Hart and Spearman[1], we can calculate the correlations between columns (or rows) of coefficients in Table XV, the criterion being that the Theory of a General Factor demands that these shall be + 1 (within the limits of experimental error). Denoting any two columns by $a$ and $b$ respectively, the raw coefficients are given by the formula

$$R_{ab} = \frac{S(\rho_{ax}\rho_{bx})}{\sqrt{S(\rho^2_{ax}) \cdot S(\rho^2_{bx})}}$$

where $\rho_{ax}$ denotes $r_{ax} - \bar{r}_{ax}$, the score over the letter denoting the average for all values of $x$; and $\rho_{bx}$ has a similar meaning. The coefficients corrected for errors of sampling in the $r$'s are given by

$$R'_{ab} = \frac{S(\rho_{ax}\rho_{bx}) - (n-1)\, r_{ab}\, \overline{\sigma_{ax}\sigma_{bx}}}{\sqrt{S(\rho^2_{ax}) - (n-1)\,\overline{\sigma^2_{ax}}}\ \sqrt{S(\rho^2_{bx}) - (n-1)\,\overline{\sigma^2_{bx}}}},$$

where $\sigma_{ax}$, as usual, denotes the probable error divided by ·6745, and $n$ is the number of tests in the series correlated (both of which formulae are quoted from the appendix of the paper referred to). We thus obtain the following values:

TABLE XVI.

| Pair of columns used | Raw coefficients, viz. first of above formulae | Corrected coefficients, viz. second of above formulae |
|---|---|---|
| *ab* | ·99 | 1·14 |
| *ac* | ·85 | ·91 |
| *ad* | ·98 | 1·09 |
| *ae* | ·72 | ·88 |
| *bc* | ·87 | ·93 |
| *bd* | ·95 | 1·01 |
| *be* | ·94 | 1·10 |
| *cd* | ·98 | 1·09 |
| *ce* | ·96 | 1·06 |
| *de* | — | * |
| | | Av. 1·02±·08 |

* Not up to correctional standard.

[1] Hart and Spearman, *Brit. J. Psych.*, 'General Ability, its Existence and Nature' (Vol. v. 1912).

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This result is an additional item of evidence in support of the Theory of a General Factor of Intellective Energy. It takes its place in the huge array of evidence collected by Professor Spearman from experimental tests by many investigators—the steadiness of results being such as to rival the niceties which physical measurements reveal. It should be remembered that the raw material for our own (comparatively small) contribution to this total result consisted of test-papers numbering nearly ten thousand.

### 3. 'SATURATION' OF THESE COEFFICIENTS BY '$g$' (the general factor).

By making use of the formula for 'partial' correlation (No. XI, Appendix I) we can, from any such table containing three or more tests, calculate the extent to which these coefficients depend upon the general factor, assuming that the performances do not possess any specific correlation with each other. The formula

$$r_{ag} = \sqrt{\frac{r_{ab} \cdot r_{ac}}{r_{bc}}}.$$

proved in the footnote[1] enables us to do this. These 'saturation coefficients' are as follows:

[1] This proof is adopted from Hart and Spearman, 'Mental Tests in Dementia,' in the *Journal of Abnormal Psychology*, Oct.–Nov. 1914.

Yule's formula is

$$r_{12.3} = \frac{r_{12} - r_{13} \cdot r_{23}}{\sqrt{1 - r^2_{13}}\sqrt{1 - r^2_{23}}}.$$

Let $a$, $b$, and $c$ be any three of these tests, and let $g \equiv$ the general factor. Then, by hypothesis,

$$r_{ab.g} = \frac{r_{ab} - r_{ag} \cdot r_{bg}}{\sqrt{1 - r^2_{ag}}\sqrt{1 - r^2_{bg}}} = 0,$$

$$r_{ac.g} = \frac{r_{ac} - r_{ag} \cdot r_{cg}}{\sqrt{1 - r^2_{ag}}\sqrt{1 - r^2_{cg}}} = 0,$$

$$r_{bc.g} = \frac{r_{bc} - r_{bg} \cdot r_{cg}}{\sqrt{1 - r^2_{bg}}\sqrt{1 - r^2_{cg}}} = 0,$$

$$\therefore\ r^2_{ag} = \frac{r_{ab} \cdot r_{ac}}{r_{bc}} \text{ and similarly for } r^2_{bg} \text{ and } r^2_{cg}.$$

Similarly also,

$$r^2_{ag} = \frac{r_{ab} \cdot r_{ad}}{r_{bd}} = \frac{r_{ab} \cdot r_{ac}}{r_{bc}} = \dots \text{ etc.}\dots$$

$$= \frac{\Sigma_{xy}(r_{ax} \cdot r_{ay})}{\Sigma_{xy}(r_{xy})} = \frac{A^2 - A'}{2T - 2A},$$

where $A \equiv$ sum of the correlations between $a$ and every other test,

$A' \equiv$ sum of the squares of these correlations,

and $T \equiv$ total of all the correlations between different tests.

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Degree of saturation of Test (*a*) with '*g*' = $r_{ag}$ = ·94
" " " " (*b*) " = $r_{bg}$ = ·85
" " " " (*c*) " = $r_{cg}$ = ·67
" " " " (*d*) " = $r_{dg}$ = ·42
" " " " (*e*) " = $r_{eg}$ = ·37

## 4. Obtaining the coefficients between the experimentally measured '*g*' and the various estimates.

The marks for these tests together with the above coefficients of their 'saturation' by the general factor (*g*) ought to furnish a measure of '*g*' itself—a measure which, when found, will be exceedingly useful to us; we shall be able to compare the *estimated* degrees of intelligence with the *experimental* measures of it, and by this means help to elucidate the nature of the estimates.

Since the first test gives a correlation with '*g*' of ·94 this alone might be used; but a more satisfactory procedure seems to be to use all the tests and to weight the marks for those which give a high correlation with '*g*' more heavily than the others. The procedure adopted here is to weight the tests proportionally to the squares of their correlation with '*g*.'

Now
$$r_{ag} = \cdot 94, \ \therefore \ r^2_{ag} = \cdot 88$$
$$r_{bg} = \cdot 85, \ \therefore \ r^2_{bg} = \cdot 72$$
$$r_{cg} = \cdot 67, \ \therefore \ r^2_{cg} = \cdot 46$$
$$r_{dg} = \cdot 42, \ \therefore \ r^2_{dg} = \cdot 19$$
$$r_{eg} = \cdot 37, \ \therefore \ r^2_{eg} = \cdot 14.$$

We have therefore

(A) Pooled tests 1 and 4, weighting the marks in the ratio of $5 : 1 \left(\text{approx. } \frac{\cdot 88}{\cdot 19}\right)$,

(B) Pooled tests 2, 3 and 5, weighting the marks in the ratio of 6 : 4 : 1 (approx. ·76 : ·46 : ·14),

and so obtained two new marks (for each subject) which are as *representative of the general factor as possible, making use of the data supplied by all our tests.* These marks, when regraded into our seven-fold scale (+ 3, + 2, etc.) and again pooled, furnish No. 46 of Table VI—the correlations of '*g*' with the estimations of all the qualities dealt with.

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### 5. THEORY AS TO THE NATURE OF '*g*.'

We have shown that our experimental tests give a strikingly thorough support to the theory of a 'general common factor as being more or less operative in all intellectual performances,' and that this '*g*' is no less operative in 'higher' processes (such as reasoning, generalisation, comparison, and the 'intelligence' which is called upon to deal with the practical problems met with throughout life) than it is in those processes which are conceived to be 'simpler' (such as sensory discrimination of touch, weight, pitch, etc.; motor activity and so on). An oft-repeated innuendo as to the value of 'mental tests' is to the effect that conclusions drawn from such 'laboratory artifacts' as nonsense syllables, aesthesiometric measurements, counting taps, card dealing, to mention only a few, may not represent the truth for performances which are complex in nature and more analogous to the performances required for practical efficiency in life. Our third test (problematical situations) was definitely planned to meet this point. The exercises were devised to present situations that easily might happen in ordinary life to the persons tested, and that would require

(1) the intelligent recognition of a number of alternative courses of procedure with reasons for and against either of them being adopted, and

(2) a choice to be made from these, judging them from the point of view of greatest advantage and least disadvantage.

These requirements correspond as nearly as possible to the successive demands of life upon one's practical efficiency—we apprehend a new situation in all its bearings (or as many of them as we can compass), and make a decision as to how to act. This test thus approximates closely to the 'common-sense' of every-day life.

Our work, when added to the much larger bulk of experiments which have been made with 'simpler' processes, has revealed that at least one such conclusion—that of the general common factor—is equally valid for *all* intellectual performances, 'simple,' 'complex' and 'practical' alike.

This being so, no hypothesis as to its nature can stand which attempts to associate it more or less exclusively with one type of intellectual activity (e.g. to memory, or discrimination, or judgment, etc.). It is much more feasible to think of it as a *constant* representing a fundamental measurement of any particular mind (the mind being thought of as a working agent) comparable to the 'horse-power' of a motor-car. The H.P. of the machine represents its constant maximum power of doing

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work and depends upon the machine's whole configuration—the actual *effective* performance of work is only modified by influences external to this (such as friction, load carried, parts out of gear, etc., and these have their analogues in the mind, distraction, fatigue, low state of health, etc.).

### 6. An attempt to examine the nature of '*g*' in the light of its correlations.

The correlations of the experimentally measured '*g*' with the various estimates are entered in Table VI. A graphic representation of them is given on p. 41—this seems to reveal more information than a column of figures.

If we take these correlations in groups, we find:

(*a*) All the *intelligence* qualities show good correlation—that giving the least being 'common-sense':

| | |
|---|---|
| Quickness of apprehension .. .. | ·53 |
| Profoundness of apprehension .. .. | ·56 |
| Common-sense .. .. .. .. | ·29 |
| Originality of ideas .. .. .. | ·47 |

It is very significant that '*g*' gives a high correlation with 'examinational ability' (No. 43 = + ·67) and, indeed, the whole range of '*g*''s correlations follows very closely the same course as those for examination. It is thus apparent that whatever else may be said of our five tests (which took about two hours in all to administer) they are at least as effective, and furnish as high correlations with the estimates, as a series of three protracted examinations, in all subjects of the curriculum, each occupying about a week of college time.

(*b*) In the *emotions* it is markedly correlated (inversely) with 'quick oscillation between cheerfulness and depression, as opposed to permanence of mood' (No. 2 = − ·39) and this is exactly the quality (among the emotions) which our growing knowledge of 'mentally defective' persons and imbeciles leads us to expect[1].

Thus the characteristics which distinguish these from normal persons are exactly the same as those which constitute the differentiation in varying grades of normal persons. Among the latter we observe certain limited ranges from intelligence to stupidity, and from permanence of mood to quick oscillation; and the marked features of the 'mentally defective' appear to be merely excessive degrees of these,

[1] See also Abelson, 'Mental Ability of Backward Children,' *B. J. P.* IV. 1911.

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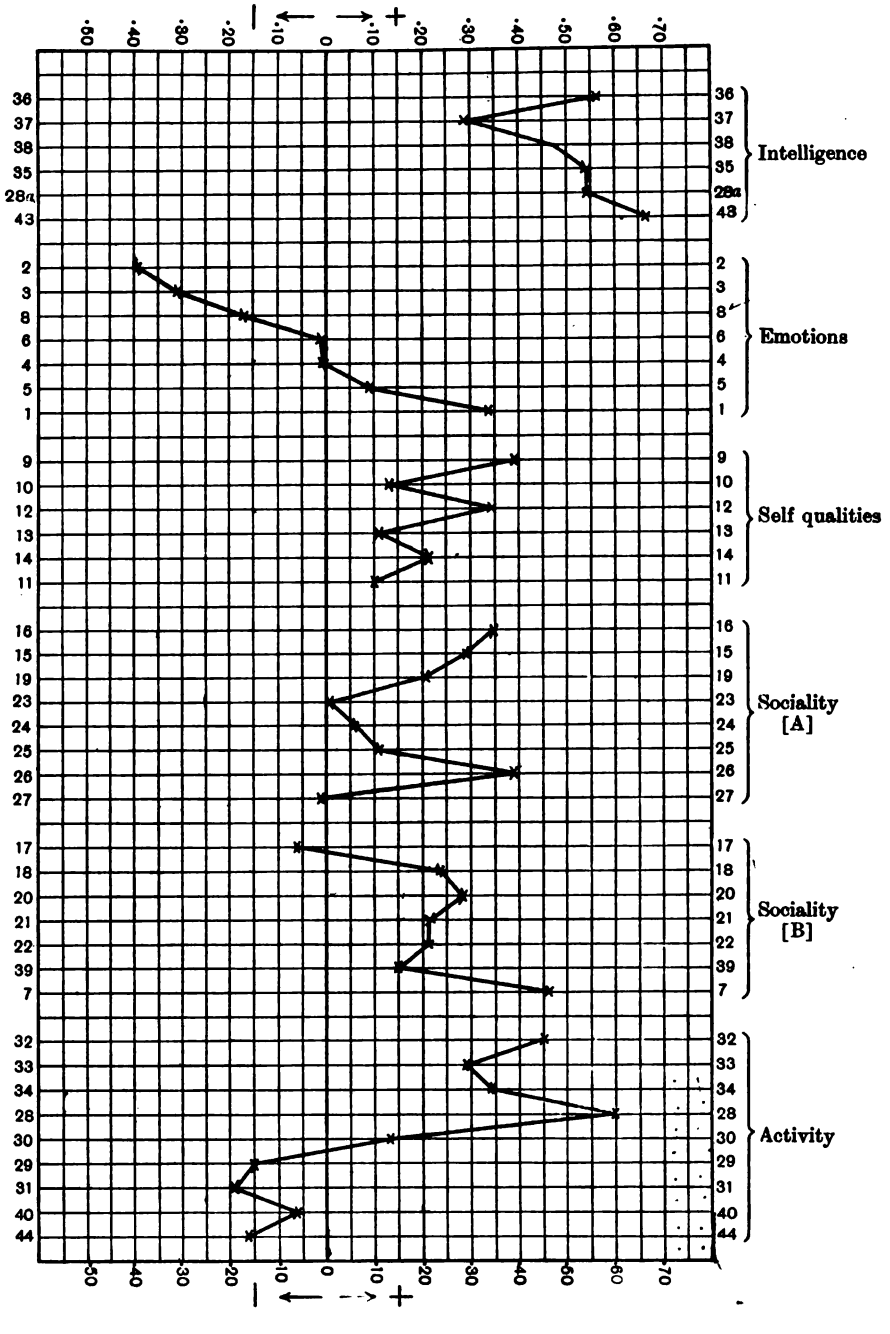


Fig. 3. Curve representing the extent of correlation (corrected) of '*g*' with all the other measurements and estimates. For names of qualities signified by the numbers at top, see list page 13 (*et seq.*).

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lying beyond the normal range, the differences being quantitative, rather than qualitative.

There is also significant correlation with the sthenic quality 'cheerfulness' (No. 1 = + ·34).

(*c*) In the '*Self qualities*' group the correlations are low, and, to all intents and purposes, neutral, except No. 9 ('desire to excel' = + ·39) and No. 12 ('belief in his own powers' = + ·35) both of which qualities are sthenic, and calculated to occur more with a high '*g*' than with a low one.

(*d*) Under '*Sociality* (A) and (B)' there are no high correlations—those which are at all marked being what may be called the *good* qualities (i.e. having a high moral value) while Nos. 15 and 16 signify a moderate 'social' habit.

(*e*) Under '*Activity*' there is very marked correlation with 'mental work in usual studies' (No. 28 = + ·60) and less, but quite decidedly significant amounts with 'remote purpose' (No. 32 = + ·45) and 'perseverance' (No. 33 = + ·28 and No. 34 = + ·34). It is noteworthy here that the correlation sinks to insignificance with bodily physique (No. 40 = − ·07), and to a small inverse degree with pursuit of pleasure, athletics, etc. (No. 29 = − ·15, No. 31 = − ·19, No. 44 = − ·17).

It is doubtful whether these have any significance—with the boys the figures are:

| | |
|---|---|
| Bodily physique .. .. .. .. .. | + ·04 |
| Mental activity in pursuit of pleasures .. | + ·26 |
| Bodily activity in pursuit of pleasures .. .. | + ·26 |
| Athletics .. .. .. .. .. .. | + ·27 |

but it is very significant that the prefects, in judging their fellow-students, give decidedly *less* correlation (with '*g*') for bodily activity and athletics than the school teachers in judging their pupils.

Collecting these observations, we may say that the possession of a good degree of '*g*,' i.e. of pure intellectual ability (the general factor—whatever it may eventually prove to be—which produces the correlation between dissimilar tests),

(1) is revealed[1] in most attempts to estimate intelligence qualities,

(2) tends to occur in persons with stability of emotions, some cheerfulness added to a fair degree of sociality, with marked application to duty and some foresight and perseverance.

[1] To what extent the estimates differ from '*g*' will be dealt with later.

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For the boys' results, the highest correlations of the two Experimental Tests (No. 28) (which in their case is the only measure of '*g*' we possess) are:

(*a*) *Intelligence:* 'quickness' + ·60, 'profoundness' + ·57, 'common-sense' + ·46 and 'originality' + ·46.

(*b*) *Emotions:* 'cheerfulness' + ·30, while 'oscillation' is neutral.

(*c*) *Self qualities:* 'eagerness for admiration' +·49 and 'desire to excel' + ·51.

(*d*) *Sociality:* 'companionship' + ·58, 'personal influence' + ·34.

(*e*) *Activity:* 'perseverance' + ·45, 'mental work in usual studies' + ·44, 'bodily activity in school hours' + ·57;

and these are *all* the coefficients over ·30!

The large number of neutral or 'insignificant' correlations with '*g*' shown in these results, so far from being a difficulty, furnishes some indication of the *purity* of '*g*' as a mental constant.

7. THE ESTIMATES OF INTELLIGENCE-QUALITIES COMPARED WITH THE EXPERIMENTALLY-MEASURED '*g*.' THE NATURE OF 'ESTIMATES' OF INTELLIGENCE EXAMINED.

The correlations of '*g*' with these are as follows:

| | Men | Boys |
|---|---|---|
| Quickness of apprehension .. .. .. | ·53 | ·60 |
| Profoundness of ditto .. .. .. .. | ·56 | ·57 |
| Common-sense .. .. .. .. .. | ·29 | ·46 |
| Originality of ideas .. .. .. .. | ·47 | ·46 |
| Power of getting through mental work *rapidly* | ·54 | — |
| Lecturers' (or Teachers') 'general' estimate .. | ·37 | ·28 |
| Prefects' 'general' estimate .. .. .. | ·36 | — |
| Examinational ability (measured, not an estimate) | ·67 | — |

These are certainly high and significant, and among the highest correlations of '*g*' with any of the estimates, but the question naturally arises why they are not higher—the inter-correlations among the estimates themselves reaching in all cases over ·80. Our '*g*' is based upon definite measurements controlled as accurately as possible—the estimates are the best efforts of prefects and others to separate out (in thought) the particular quality from all others, and assess it. Have the prefects and others, in making their estimates, been able to do this? The answer must be sought in a comparison of the estimates with the experimentally measured '*g*.' We can examine the tables (VI for men and VII for boys) and look for qualities which give markedly different correlations with '*g*' from those with the estimates of the above intelligence qualities. In the men's results we at once find one which, though

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giving practically no correlation with '*g*,' has very high correlation with the estimates, viz. No. 8 Degree of sense of humour. The coefficients are:

| | | |
|---|---|---|
| With quickness of apprehension | ·85 | Estimates |
| „ profoundness of apprehension | ·49 | |
| „ common-sense | ·45 | |
| „ originality of ideas | ·79 | |
| „ lecturers' estimate of character in general | −·04 | |
| „ prefects' „ „ „ | ·27 | |
| „ examinational ability | ·18 | Objective criteria |
| „ '*g*' | ·17 | |

This observation reveals the rather unexpected fact that the prefects, in making their estimates of the intelligence qualities, were largely guided and biased by this consideration—sense of humour, a bias from which the lecturers were naturally quite free. This result, though unexpected, seems very natural now that it emerges from the data—humour being frequently used as a very readily accessible criterion of quick intellectual performance. Our objective results show, though, that it is a misleading criterion; actually humour has very little '*g*' in it, depending mainly upon affective and conative tendencies.

We can probe the matter further by means of 'partial correlation' (No. XI, Appendix I). Using Yule's formula for three variables we can find the 'partial' correlation between '*g*' and the estimates *with the influence of No. 8—humour—eliminated.* The results are:

TABLE XVII.

| | Correlations with '*g*' | |
|---|---|---|
| | 'Whole' coefficients | Partial coefficients (3 variables) with No. 8 (humour) constant |
| Quickness of apprehension | ·53 | 1·16 |
| Profoundness of apprehension | ·56 | ·75 |
| Common-sense | ·29 | ·42 |
| Originality of ideas | ·47 | 1·00 |

Here, then, is the answer to our question. The (comparatively) low correlations of '*g*' with the estimates are largely due to bias in the minds of the persons making them; in the case of the prefects, this bias is very marked in favour of 'sense of humour[1]'; that is, the prefects, in assessing intelligence-qualities, are unable to separate out (in thought) the particular quality under consideration.

[1] It will become apparent, later, that a general bias occurs in favour of several other desirable qualities.

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Another profitable course of procedure—in considering the nature of 'estimates'—is to make use of our new method (Chapter III, Sect. 5) of examining the 'correlations of the correlations,' to see what light they throw upon the 'build' of the qualities. With both our groups of subjects we obtained estimates for

1. Quickness of apprehension (men No. 35, boys No. 20).
2. Profoundness of intelligence (men No. 36, boys No. 21).
3. Common-sense (men No. 37, boys No. 22).
4. Originality of ideas (men No. 38, boys No. 23).

Their correlations with each other, and the 'correlations of their correlations' are given in the following tables.

TABLE XVIII A (*men*).

| | Quickness | | Originality | | Profoundness | | Common-sense | |
|---|---|---|---|---|---|---|---|---|
| | Correlation between qualities | Correlation of the correlation | Correlation between qualities | Correlation of the correlation | Correlation between qualities | Correlation of the correlation | Correlation between qualities | Correlation of the correlation |
| Quickness | — | — | 1·04 | ·91 | ·96 | ·73 | ·81 | ·69 |
| Originality | 1·04 | ·91 | — | — | ·88 | ·84 | ·84 | ·81 |
| Profoundness | ·96 | ·73 | ·88 | ·84 | — | — | 1·00 | ·94 |
| Common-sense | ·81 | ·69 | ·84 | ·81 | 1·00 | ·94 | — | — |

TABLE XVIII B (*boys*).

| | Quickness | | Originality | | Profoundness | | Common-sense | |
|---|---|---|---|---|---|---|---|---|
| | Correlation between qualities | Correlation of the correlation | Correlation between qualities | Correlation of the correlation | Correlation between qualities | Correlation of the correlation | Correlation between qualities | Correlation of the correlation |
| Quickness | — | — | 1·08 | ·89 | 1·14 | ·93 | 1·06 | ·89 |
| Originality | 1·08 | ·89 | — | — | ·99 | ·73 | ·89 | ·66 |
| Profoundness | 1·14 | ·93 | ·99 | ·73 | — | — | 1·11 | ·99 |
| Common-sense | 1·06 | ·89 | ·89 | ·66 | 1·11 | ·99 | — | — |

The correlations between the estimates of the qualities are all very high, but the 'correlations of the correlations' (see Chap. III, Sect. 5) reveals a closer association between *quickness* and *originality* on the one hand, and between *profoundness* and *common-sense* on the other, and consequently, also, some differences between the two pairs of qualities (i.e. as they were conceived in the minds of the judges).

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We must proceed to examine the correlations for the four estimates in detail—on the lines of the example given in Chap. III, Sect. 5. The following tables give particulars of *all* the instances in which

A. the correlations for Quickness exceed those for Profoundness,

B. the correlations for Quickness are less than those for Profoundness,

C. the correlations for Quickness exceed those for Common-sense,

D. the correlations for Quickness are less than those for Common-sense,

E. the correlations for Quickness exceed those for Originality,

F. the correlations for Quickness are less than those for Originality,

G. the correlations for Profoundness exceed those for Common-sense,

H. the correlations for Profoundness are less than those for Common-sense.

Only differences of three times the probable error or more are given, *all* these are given, and where one group shows this difference while the other group does not, the actual excess (or defect) is given in brackets.

## TABLE XIX.

A. *Quickness of apprehension* (No. 35 men and 20 boys) goes more than *Profoundness of intelligence* (No. 36 men and 21 boys) in:

| *Men's Results* | | | *Boys' Results* | | |
|---|---|---|---|---|---|
| No. in table | | Excess | No. in table | | Excess |
| 1 | Cheerfulness | ·33 | 1 | Cheerfulness | (−·05) |
| 4 | Anger | ·38 | 2 | Anger | ·25 |
| | (not estimated) | | 4 | Fear | ·24 |
| 3 | Occasional liability to extreme depression | ·26 | | (not estimated) | |
| 8 | Sense of humour | ·36 | | ,, ,, | |
| 10 | Intolerance | ·32 | 7 | Intolerance | ·45 |
| 11 | Eagerness for admiration | ·48 | 8 | Eagerness for admiration | ·30 |
| 14 | Excessive self-esteem | ·38 | | (not estimated) | |
| 15 | Fondness for large social gatherings | ·58 | | ,, ,, | |
| 31 | Bodily activity in pursuit of pleasure (games, etc.) | ·35 | 17 | Bodily activity in pursuit of pleasures | ·22 |
| 44 | Athletics | ·27 | 25 | Athletics | (−·07) |

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B. *Profoundness of intelligence* (36 and 21) goes more than *Quickness of apprehension* (35 and 20) in:

| *Men's Results* | | | *Boys' Results* | | |
|---|---|---|---|---|---|
| No. in table | | Excess | No. in table | | Excess |
| 5 | Recovery from anger | (+·03) | 3 | Recovery from anger | ·59 |
| 16 | Fondness for small circle of special intimates | ·42 | | (not estimated) | |
| 18 | Kindness on principle | ·23 | 10 | Kindness | ·23 |
| 20 | Trustworthiness | ·26 | 11 | Trustworthiness | ·30 |
| 21 | Conscientiousness | ·42 | 12 | Conscientiousness | ·28 |
| 22 | Religion | ·51 | | (not estimated) | |
| 28 | Mental work in usual studies | ·44 | 14 | Mental work in usual studies | (+·12) |
| 32 | Tendency to work with remote purpose | ·48 | | (not estimated) | |
| 34 | Absence of changeability | ·31 | 19 | Absence of changeability | ·23 |
| 39 | Pure-mindedness | ·36 | | (not estimated) | |
| 41 | General estimate by staff | ·47 | 27 | General estimate by teachers | (+·12) |
| 42 | General estimate by students | ·27 | | (not estimated) | |

C. *Quickness of apprehension* (35 and 20) goes more than *Common-sense* (37 and 22) in:

| *Men's Results* | | | *Boys' Results* | | |
|---|---|---|---|---|---|
| No. in table | | Excess | No. in table | | Excess |
| 1 | Cheerfulness | ·25 | 1 | Cheerfulness | (+·01) |
| 4 | Anger | ·52 | 2 | Anger | ·43 |
| | (not estimated) | | 4 | Fear | ·31 |
| 6 | Occasional liability to extreme anger | ·36 | | (not estimated) | |
| 8 | Sense of humour | ·40 | | ,, ,, | |
| 10 | Intolerance | ·44 | 7 | Intolerance | ·51 |
| 11 | Eagerness for admiration | ·55 | 8 | Eagerness for admiration | ·30 |
| 13 | Self-esteem | ·37 | | (not estimated) | |
| 14 | Superciliousness | ·59 | | ,, ,, | |
| 15 | Fondness for large social gatherings | ·54 | | ,, ,, | |
| 24 | Desire to be liked | ·36 | 13 | Desire to be liked | (+·16) |
| 31 | Bodily activity in pursuit of pleasures | ·41 | 17 | Bodily activity in pursuit of pleasures | (+·05) |
| 28 *a* | Power of getting through mental work *rapidly* | ·26 | | (not estimated) | |

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D. *Common-sense* (37 and 22) goes more than *Quickness of apprehension* (35 and 20) in:

| *Men's Results* | | | *Boys' Results* | | |
|---|---|---|---|---|---|
| No. in table | | Excess | No. in table | | Excess |
| 5 | Recovery from anger | ·27 | 3 | Recovery from anger | ·60 |
| 16 | Fondness for small circle of special intimates | ·33 | | (not estimated) | |
| 18 | Kindness on principle | ·33 (+·17) | 10 | Kindness | ·40 |
| | | | 11 | Trustworthiness | ·40 |
| 21 | Conscientiousness | ·40 | 12 | Conscientiousness | ·37 |
| 22 | Religion | ·49 | | (not estimated) | |
| 23 | Readiness to accept the sentiments of others | ·32 | | ,, ,, | |
| 28 | Mental work in usual studies | ·37 | 14 | Mental work in usual studies | (+·07) |
| 32 | Tendency to work with remote purpose | ·40 | | (not estimated) | |
| 34 | Absence of changeability | ·33 | 19 | Absence of changeability | ·36 |
| 39 | Pure-mindedness | ·43 | | (not estimated) | |
| 41 | 'General' estimate by staff | ·38 | 27 | 'General' estimate by teachers | (+·06) |
| 42 | 'General' estimate by students | ·38 | | (not estimated) | |
| 43 | Examinational ability | ·27 | | (not measured) | |

E. *Quickness of apprehension* (35 and 20) goes more than *Originality of Ideas* (38 and 23) in the following only:

Intolerance (men ·24, boys + ·02).
Eagerness for admiration (men 24, boys − ·22).
Bodily activity in pursuit of pleasures (men ·20, boys − ·16).
Teachers' General Estimate (men − ·11, boys ·25).

F. *Originality of Ideas* (38 and 23) goes more than *Quickness of apprehension* (35 and 20) in the following only:

Bodily activity in school hours (men ·20, boys ·29).
Examinational ability (men ·22, boys no measurement).
Recovery from anger (men − ·03, boys ·33).

G. *Profoundness of intelligence* (36 and 21) goes more than *Common-sense* (37 and 22) in the following only:

Superciliousness (inversely) (men ·21, boys (no estimate)).
The general factor (men ·28, boys (no estimate)).

H. *Common-sense* (37 and 22) goes more than *Profoundness of intelligence* (36 and 21) in the following only:

Occasional liability to extreme depression (inversely) (men ·23, boys (no estimate)).
Recovery from anger (men ·24, boys + ·01).

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Add to these tables the fact that the 'general' estimates of character give the following results:

TABLE XX.

| | | Students' 'general' estimates (men) | Staff's 'general' estimates (men) | Teachers' 'general' estimates (boys) |
|---|---|---|---|---|
| A. | With Quickness | ·50 | ·15 | ·82 |
| | „ Originality | ·55 | ·26 | ·59 |
| B. | „ Profoundness | ·77 | ·62 | ·94 |
| | „ Common-sense | ·88 | ·53 | ·88 |

and we have collected the material for some important truths which emerge:

(*a*) The judges (20 prefects and 8 class-masters) in making their estimates of these four 'qualities,' had two distinct points of view from which they regarded intelligence-qualities. One is revealed in the pair, Quickness and Originality, which in our further discussion we will call *Quick Intelligence*, the other in the pair, Profoundness and Common-sense, which we will now call *Profound Intelligence*.

(*b*) The estimates under *Quick Intelligence* reveal the facts that these are coloured by (see specially Tables A and C)

1. a marked emotional 'set' or temperament,
2. strong egoism,
3. the lighter social qualities,
4. bodily activity and pursuit of pleasure.

(*c*) The estimates under *Profound Intelligence* reveal the facts that these are coloured by (see specially Tables B and D)

1. a calm temperament,
2. much less egoism,
3. the deeper social qualities,
4. mental activity, and purposive performance of duty.

This dual aspect of the intelligence-qualities (in the minds of the judges), with the very definite system which appears to underlie their differences, suggests an examination of the qualities which constitute these differences—a task which opens out in so many interesting and profitable directions that it is more convenient to deal with it in a separate chapter.

(*d*) It is manifest that, when teachers (and others) make (undifferentiated) estimates of 'General Intelligence,' they must 'pool' this two-fold aspect in some proportion.



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(*e*) A glance at our last little table (XX) on 'general' estimates (in which without exception the correlations with Profound Intelligence are higher than with Quick Intelligence) reveals the further fact that these (undifferentiated) estimates of 'General Intelligence,' in pooling the two aspects, attach more weight to Profoundness and Common-sense than to the other two.

(*f*) The concept 'General Intelligence' is thus a complex containing

I. The general factor '*g*'—the intellective efficiency denuded of all else.

II. Other factors underlying the differences noted above among the intelligence-qualities.

III. Other elements still—conceptual and fallacious. Some of these we sought to eliminate in our method—our several judges, their independence of work, the avoidance of a special bias (e.g. lecturers), etc. But some must remain (e.g. any 'atmosphere' distinctive of the college attended by all the adult subjects was common to all our judges; and any bias due to a national character must remain in both our sets of results) and always will remain until such concepts as 'general intelligence' can be presented with much more definiteness of meaning to the minds of a series of judges, or are abandoned in favour of terms which are strictly definite.

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# CHAPTER V

## A SECOND GENERAL FACTOR

1. *The only known general factor, 'g.' The possibility of further general factors.*
2. *Examination of data for the existence of a second general factor on the side of 'Character.'*
3. *Hypothesis of a second general factor (on the side of character) definitely put forward.*
4. *Consideration of the nature of this second general factor—'Persistence of motives.'*
5. *Examination of the literature of character-study in the light of this suggestion; Müller, Heymans and Wiersma, Gross, Meumann, Partridge, Rath, Culler, Ach.*

### 1. THE ONLY KNOWN GENERAL FACTOR, '*g*.' THE POSSIBILITY OF FURTHER GENERAL FACTORS.

Up to the present time the only general factor which has been shown to exist for all mental processes is the '*g*.' The theory referring to this has stood the test of a very wide range of investigations and its authors seem fully justified in their expectation that is must have 'far-reaching bearings upon psychological theory and practice.' There is no a priori ground either for affirming or denying the existence of further general factors, but the definite system revealed above in relation to the two-fold aspect of intelligence (as estimated) at least suggests the possible existence of another. These differences are chiefly related to character, and they seem to point to some degree of generality on this side of the mind also.

It is highly important to realise the force of the terms 'general' and 'generality.' Many writers, in seeking to diagnose and classify individuals, have asserted or implied a generality, and named it in various



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ways according to the system they are arbitrarily adopting. A few of these unwarranted generalisations which have been put forward are: passion, will, pleasures and pains and their corresponding interests; strength and weakness of activity; speed of activity; vitality (sanguine, choleric, etc.), primary and secondary functions; spontaneity; easy and difficult reactibility. It is interesting to note that on the side of intelligence, the old 'faculty' psychology imposed confusion and error upon knowledge by means of just such a chaos of terms—a chaos which has been largely dispelled by the theory of '*g*' and its methodics.

But all that these writers have really done is to observe a person's actions to have certain characteristics *under certain particular conditions*. They have never produced, nor even tried to produce, any evidence of the same person exhibiting the same characteristics *generally*, that is to say, under varied conditions. Their observations were confined to descriptive analysis and did not touch functional dependence. For example, a person is observed to remember well certain things seen a long time ago, and is thereupon declared to have a retentive memory. But this mode of expression makes the quite unwarranted implication that he could also retain well other experiences such as nonsense-syllables or the words of a foreign language. For descriptive purposes it is right to include all these processes under the general name of memory but by this we do not prove the one ability to accompany the other, that is to say, to have functional generality. Quite similar illegitimate generalisations have always been made with regard to character also, e.g. the qualities 'kindness' and 'conscientiousness' are both called *moral* qualities and the word *moral* is forthwith used in such a way as to imply a functional connection between them. Such verbal generalisations have always been serious pitfalls in the path of science, they are 'idola fori' which "as a Tartar's bow, do shoot back upon the understanding of the wisest, and mightily intangle and pervert the judgment."

But if we reject these unwarranted generalities, we are faced by the fact that really to demonstrate functional generalities is an extremely difficult task. It requires elaborate methods such as were formerly unknown and unsuspected. But in the development of the theory of '*g*' the required methods have at last been devised. Here it is shown that the factor '*g*' is *functionally* operative in producing correlation between mental performances, this correlation being always partly due to the '*g*' and partly due to specific abilities called into play by the specific nature of the performances. The technique devised and used by the authors of this theory is designed to demonstrate that for any

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mental performances, sufficiently dissimilar, the correlation between columns of the inter-correlations among the separate performances becomes + 1, and this has been shown to indicate that each performance depends on two factors, one different for each performance, but the other, our '*g*,' common to them all.

## 2. EXAMINATION OF DATA FOR THE EXISTENCE OF A SECOND GENERAL FACTOR ON THE SIDE OF CHARACTER.

Our method of attack upon the character-qualities may be similar to that used for the '*g*,' and we can make use of the same technique. We can examine these qualities and seek for any general factor that may be functionally operative in them all. To do this we may first of all tabulate the qualities which constitute the definite system existing among the differences between 'quick' and 'profound' intelligence (as estimated). Table XXI (p. 54) gives these in two sections, Section A containing those whose correlation with 'quickness' is significantly less than with 'profoundness'; and Section B those whose correlation with 'quickness' significantly exceeds those with 'profoundness.'

Without exception, the qualities in Section A correlate more highly with the 'profoundness' estimates, the average difference being ·32, and conversely those in Section B correlate more highly with the 'quickness' estimates, the average difference being ·37. We now have simply to draw up a table of the inter-correlations of these qualities and examine this table for 'correlation between correlations' (i.e. adopting the method devised by Spearman and Hart to demonstrate the existence of '*g*'—the formulae, together with their application to our own data on the side of intelligence, are given in Chapter IV).

Commencing with the boys, we take all their estimates that occur in Table XXI; this gives us:

*Section A.*

No. 19. Tendency *not* to abandon tasks from mere changeability.
18. Perseverance in face of obstacles.
10. Kindness on principle.
11. Trustworthiness.
12. Conscientiousness.

*Section B.*

No. 2. Readiness to become angry.
8. Eagerness for admiration.
17. Bodily activity in pursuit of pleasure (games, etc.).

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## TABLE XXI.

| No. in Students' schedules | No. in Boys' schedules | | Profoundness of Intelligence: Students — Profoundness of apprehension | Profoundness of Intelligence: Students — Common-sense | Profoundness of Intelligence: Boys — Profoundness of apprehension | Profoundness of Intelligence: Boys — Common-sense | Quickness of Intelligence: Students — Quickness of apprehension | Quickness of Intelligence: Students — Originality of ideas | Quickness of Intelligence: Boys — Quickness of apprehension | Quickness of Intelligence: Boys — Originality of ideas |
|---|---|---|---|---|---|---|---|---|---|---|
| | | SECTION A | 36 | 37 | 21 | 22 | 35 | 38 | 20 | 23 |
| 34 | 19 | Tendency *not* to abandon tasks from mere changeability | +·71 | +·73 | +·38 | +·51 | +·40 | +·48 | +·15 | −·11 |
| 32 | — | Degree in which he works with a distant object in view | +·75 | +·67 | — | — | +·27 | +·36 | — | — |
| 33 | 18 | Perseverance in face of obstacles | +·72 | +·77 | +1·11 | +·97 | +·59 | +·69 | +1·05 | +·76 |
| 18 | 10 | Kindness on principle | +·69 | +·79 | +·52 | +·69 | +·46 | +·47 | +·29 | +·10 |
| 20 | 11 | Trustworthiness | +·66 | +·57 | +·71 | +·81 | +·40 | +·46 | +·41 | +·32 |
| 21 | 12 | Conscientiousness | +·66 | +·64 | +·75 | +·84 | +·24 | +·43 | +·47 | +·32 |
| 22 | — | Religion | +·54 | +·52 | — | — | +·03 | +·18 | — | — |
| 39 | — | Pure-mindedness | +·47 | +·54 | — | — | +·11 | +·15 | — | — |
| 28 | 14 | Mental work in usual studies | +·74 | +·67 | +1·07 | +1·02 | +·30 | +·40 | +·93 | +·75 |
| | | | Av. = +·71 | | | | Av. = +·39 | | | |
| | | SECTION B | 36 | 37 | 21 | 22 | 35 | 38 | 20 | 23 |
| 2 | — | Quick oscillation between cheerfulness and depression as opposed to permanence of mood | −·46 | −·51 | — | — | −·38 | −·36 | — | — |
| 4 | 2 | Readiness to become angry | −·39 | −·53 | −·24 | −·42 | −·01 | −·09 | +·01 | +·20 |
| 11 | 8 | Eagerness for admiration | −·29 | −·37 | +·13 | +·13 | +·19 | −·07 | +·43 | +·65 |
| 13 | — | Esteem of himself as a whole | −·05 | −·20 | — | — | +·17 | +·27 | — | — |
| 14 | — | Offensive self-esteem (superciliousness) | −·28 | −·49 | — | — | +·10 | +·13 | — | — |
| 15 | — | Fondness for large social gatherings | −·16 | −·12 | — | — | +·42 | +·44 | — | — |
| 31 | 17 | Bodily activity in pursuit of pleasure (games, etc.) | +·02 | −·04 | +·04 | +·21 | +·37 | +·17 | +·26 | +·42 |
| | | | Av. = −·21 | | | | Av. = +·16 | | | |

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Table XXII gives the inter-correlations of these qualities (as drawn from the full Table VII). The accompanying figures represent the standard deviation ($\sigma$) in each case (where $\sigma$ = p.e. ÷ ·6745).

TABLE XXII. *Corrected coefficients* (*from Table VII*). Boys.

| No. in schedule | | Tendency *not* to abandon tasks from mere changeability | Tendency *not* to abandon tasks in face of obstacles | Kindness on principle | Trustworthiness | Conscientiousness | Readiness to become angry | Eagerness for admiration | Bodily activity in pursuit of pleasure (games, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | No. in schedule | 19 | 18 | 10 | 11 | 12 | 2 | 8 | 17 |
| 19 | Tendency *not* to abandon tasks from mere changeability | — | +·75<br>**·113** | +·75<br>**·117** | +·87<br>**·099** | +1·01<br>**·097** | −·87<br>**·168** | −·69<br>**·130** | −·37<br>**·112** |
| 18 | Tendency *not* to abandon tasks in face of obstacles | +·75<br>**·113** | — | +·64<br>**·100** | +·81<br>**·082** | +·95<br>**·073** | −·41<br>**·123** | +·03<br>**·118** | +·04<br>**·100** |
| 10 | Kindness on principle | +·75<br>**·117** | +·64<br>**·100** | — | +1·14<br>**·086** | +1·06<br>**·086** | −1·13<br>**·093** | −·49<br>**·144** | −·32<br>**·117** |
| 11 | Trustworthiness | +·87<br>**·099** | +·81<br>**·082** | +1·14<br>**·086** | — | +1·19<br>**·065** | −·84<br>**·099** | −·35<br>**·127** | −·18<br>**·112** |
| 12 | Conscientiousness | +1·01<br>**·097** | +·95<br>**·073** | +1·06<br>**·086** | +1·19<br>**·065** | — | −·89<br>**·096** | −·37<br>**·121** | −·36<br>**·096** |
| 2 | Readiness to become angry | −·87<br>**·168** | −·41<br>**·123** | −1·13<br>**·093** | −·84<br>**·099** | −·89<br>**·096** | — | +·59<br>**·121** | +·45<br>**·074** |
| 8 | Eagerness for admiration | −·69<br>**·130** | +·03<br>**·118** | −·49<br>**·144** | −·35<br>**·127** | −·37<br>**·121** | +·59<br>**·121** | — | +·54<br>**·109** |
| 17 | Bodily activity in pursuit of pleasure (games, etc.) | −·37<br>**·112** | +·04<br>**·100** | −·32<br>**·117** | −·18<br>**·112** | −·36<br>**·096** | +·45<br>**·074** | +·54<br>**·109** | — |

The accompanying figures in heavy type represent the $\sigma$ in each case, where $\sigma$ = p.e. ÷ ·6745.

The coefficients of this table yield Table XXIII, in which each coefficient represents the correlation ($R'_{ab}$) between the columns (or rows) of coefficients in Table XXII seriatim, e.g. the + ·96 for No. 11 with No. 19 is the correlation between columns 11 and 19 of Table XXII, and so for all the others.

An examination of this table (XXIII) supplies the evidence for deciding the question of the existence of a general factor functionally operative in all the correlations of Table XXII. The division of the qualities into two sections (A and B) results in a division of the tables into four rectangles (as marked off by the ruling).

Take first the five columns on the left of the table. The correlation between every pair of these columns approximates to + 1 (actually + ·99 ± ·02). But this is precisely the result that has been shown to ensue from the hypothesis of all the correlations being due to one and

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TABLE XXIII. *The 'correlation between columns' of Table XXII; showing the effect of Hart and Spearman's criterion.* Boys.

| No. in schedule | | Tendency *not* to abandon tasks from mere changeability | Tendency *not* to abandon tasks in face of obstacles | Kindness on principle | Trustworthiness | Conscientiousness | Readiness to become angry | Eagerness for admiration | Bodily activity in pursuit of pleasure (games, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | No. in schedule | 19 | 18 | 10 | 11 | 12 | 2 | 8 | 17 |
| 19 | Tendency *not* to abandon tasks from mere changeability | — | +·99 | +·97 | +·96 | +·98 | −1·00 | −·97 | −·96 |
| 18 | Tendency *not* to abandon tasks in face of obstacles | +·99 | — | +1·00 | +·98 | +1·08 | −·93 | −·88 | −·94 |
| 10 | Kindness on principle | +·97 | +1·00 | — | +1·00 | +·96 | −1·04 | −·88 | −·85 |
| 11 | Trustworthiness | +·96 | +·98 | +1·00 | — | +·98 | −1·02 | −·80 | −·99 |
| 12 | Conscientiousness | +·98 | +1·08 | +·99 | +·98 | — | −1·01 | −·88 | −·87 |
| 2 | Readiness to become angry | −1·00 | −·93 | −1·04 | −1·02 | −1·01 | — | +·94 | +·81 |
| 8 | Eagerness for admiration | −·97 | −·88 | −·88 | −·80 | −·88 | +·94 | — | +1·00 |
| 17 | Bodily activity in pursuit of pleasure (games, etc.) | −·96 | −·94 | −·85 | −·99 | −·87 | +·81 | +1·00 | — |

[Average ·95.]

the same common factor in all the qualities correlated. In other words, all the correlations in these five columns (of Table XXII) may be taken as being, in the main, the effect of our factor, common in varying degrees to all the *eight* qualities concerned[1].

A precisely analogous argument applies to the three columns on the right, so that also these correlations are all due to one common factor. But the values in these three and in the former five columns largely overlap, 15 of them occurring in both, so that the common factor must be the *same* for both.

But if this is the case it may be asked why the five columns on the left have not correlations of + 1 with the three on the right. The answer is simple. The fundamental equation ensuing from the hypothesis of one common factor, and furnishing the basis of the relation we have been using, viz. $R'_{ab} = +1$, is

$$\frac{r_{ap}}{r_{aq}} = \frac{r_{bp}}{r_{bq}}.$$

But this proportionality is equally well satisfied by $R'_{ab} = -1$. Our own value is $-\cdot93 \pm \cdot06$. And this is in agreement with the facts;

[1] The proof—see 'General Ability, Its Existence and Nature,' *B.J.P.* v. 80—includes the bottom three rows of these five columns, i.e. it is not disturbed by some of the correlations being negative.

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individuals who are assessed high in qualities of Section A are naturally assessed low in those of Section B, and vice versa.

This result may be contrasted with those needed to accord with other more or less plausible hypotheses. For instance, it might be supposed that the eight qualities, as estimated, were independent of one another. But in that case, the correlations between them should be approximately zero, which they are far from being. Again, it might be supposed that the qualities were not independent, but that the correlations between them were. But in that case the correlations between columns would approximate to zero, which is once more contradicted by facts. Thirdly, it might be supposed that the eight qualities are each random compounds of more elementary independent factors and that the correlation between any two qualities is due to elements which were common to both by chance. If this view were true, it can be shown[1] that, in general, the correlation between columns would then be approximately equal to the original correlations between the estimates, i.e. the coefficients of Table XXII would re-appear in Table XXIII. This again is far from according with the actual facts.

But it may be urged, and rightly so, that the proportionality (amounting nearly to unity throughout) which is obtained in Table XXIII may be derived from the '*g*'—the general intellective index extending its influence even to these qualities. The objection, however, can be met. In the case of our men subjects we have determined the correlations between the qualities and the '*g*' (No. 46 in Table VI gives the correlation of '*g*' with all the estimates). The method of partial fractions enables us to eliminate the influence of '*g*' from any of these inter-correlations. Let us therefore (1) take the inter-correlations of the estimates (for the men) for exactly the same eight qualities as we used for the boys—these are obtained from the full Table VI; (2) *eliminate from each of these coefficients the influence of* '*g*' (by Yule's formula, see Appendix I, No. XI); and (3) again apply the criterial method, that of testing whether the correlations between columns ($R'_{ab}$) become practically unity throughout. Tables XXIV and XXV give the figures.

[1] Professor Spearman has kindly undertaken to supply the proof of this later.

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TABLE XXIV. (Men.) *The 'partial coefficients' obtained by eliminating the influence of 'g' from the inter-correlations of above qualities (from Table VI).*

| No. in schedule | | Tendency *not* to abandon tasks from mere changeability | Tendency *not* to abandon tasks in face of obstacles | Kindness on principle | Trustworthiness | Conscientiousness | Readiness to become angry | Eagerness for admiration | Bodily activity in pursuit of pleasure (games, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | No. in schedule | 34 | 33 | 18 | 20 | 21 | 4 | 11 | 31 |
| 34 | Tendency *not* to abandon tasks from mere changeability | — | +·92<br>**·076** | +·58<br>**·104** | +·74<br>**·089** | +·68<br>**·094** | −·45<br>**·120** | −·55<br>**·119** | −·08<br>**·113** |
| 33 | Tendency *not* to abandon tasks in face of obstacles | +·92<br>**·076** | — | +·46<br>**·116** | +·52<br>**·102** | +·50<br>**·102** | −·29<br>**·128** | −·45<br>**·116** | +·07<br>**·132** |
| 18 | Kindness on principle | +·58<br>**·104** | +·46<br>**·116** | — | +1·06<br>**·052** | +·95<br>**·061** | −·85<br>**·080** | −·61<br>**·100** | +·11<br>**·122** |
| 20 | Trustworthiness | +·74<br>**·089** | +·52<br>**·102** | +1·06<br>**·052** | — | +1·06<br>**·041** | −·78<br>**·092** | −·78<br>**·088** | −·13<br>**·114** |
| 21 | Conscientiousness | +·68<br>**·094** | +·50<br>**·102** | +·95<br>**·061** | +1·06<br>**·041** | — | −·78<br>**·085** | −·74<br>**·088** | −·26<br>**·110** |
| 4 | Readiness to become angry | −·45<br>**·120** | −·29<br>**·128** | −·85<br>**·080** | −·78<br>**·092** | −·78<br>**·085** | — | +·93<br>**·069** | +·36<br>**·116** |
| 11 | Eagerness for admiration | −·55<br>**·119** | −·45<br>**·116** | −·61<br>**·100** | −·78<br>**·088** | −·74<br>**·088** | +·93<br>**·069** | — | +·37<br>**·101** |
| 31 | Bodily activity in pursuit of pleasure (games, etc.) | −·08<br>**·113** | +·07<br>**·132** | +·11<br>**·122** | −·13<br>**·114** | −·26<br>**·110** | +·36<br>**·116** | +·37<br>**·101** | — |

The accompanying figures in heavy type represent the $\sigma$ in each case, where $\sigma = \text{p.e.} \div .6745$.

### 3. Hypothesis of a second general factor (more specially prominent on the side of character) definitely put forward.

The evidence thus appears to be decisive; and we therefore venture to put forward the hypothesis:

*That a second factor, of wide generality, exists; and that this factor is prominent on the 'character' side of mental activity (as distinguished from the purely intellective side).*

All the facts satisfy this hypothesis, and they prove incapable of according with any other hypothesis which has so far been suggested.

### 4. Consideration of the nature of the second general factor—'persistence of motives.'

If we examine the qualities of Tables XXI and XXV upon whose correlations the above argument is based, we find that those of Section 'A' may reasonably be grouped under the headings

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(1) Moral qualities and deeper social virtues (Nos. 18, 20, 21[1]),
(2) Persistence of motives (Nos. 33, 34),

while those of Section 'B' come under

(3) Instability of emotions (No. 4),
(4) The lighter side of sociality (Nos. 11 and 31).

TABLE XXV. (Men.) *The 'correlation between columns' of Table XXIV, showing the effect of Hart and Spearman's criterion*[2].

| No. in schedule | | Tendency *not* to abandon tasks from mere changeability | Tendency *not* to abandon tasks in face of obstacles | Kindness on principle | Trustworthiness | Conscientiousness | Readiness to become angry | Eagerness for admiration | Bodily activity in pursuit of pleasure (games, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | No. in schedule | 34 | 33 | 18 | 20 | 21 | 4 | 11 | 31 |
| 34 | Tendency *not* to abandon tasks from mere changeability | — | +1·00 | +·94 | +·93 | +·94 | −·88 | −·94 | −·71 |
| 33 | Tendency *not* to abandon tasks in face of obstacles | +1·00 | — | +·92 | +1·00 | +·91 | −·86 | −·94 | −·82 |
| 18 | Kindness on principle | +·94 | +·92 | — | +·98 | +·98 | −1·03 | −1·00 | * |
| 20 | Trustworthiness | +·93 | +1·00 | +·98 | — | +1·00 | −1·00 | −·99 | −·93 |
| 21 | Conscientiousness | +·94 | +·91 | +·98 | +1·00 | — | −·99 | −1·00 | * |
| 4 | Readiness to become angry | −·88 | −·86 | −1·03 | −1·00 | −·99 | — | +·96 | +·92 |
| 11 | Eagerness for admiration | −·94 | −·94 | −1·00 | −·99 | −1·00 | +·96 | — | +·91 |
| 31 | Bodily activity in pursuit of pleasure (games, etc.) | −·71 | −·82 | * | −·93 | * | +·92 | +·91 | — |

[Average ·94.]

* Not up to the correctional standard.

[1] The numbers refer to the men's schedules. Table XXI suggests some extension of these qualities to include the further ones for which we possess data for the men, but which have not been included in our main argument. This we have based upon the eight qualities for which we possess data for both boys and men—a more extended examination of all the qualities in Table XXI gives quite similar results.

[2] It is to be noted that our results in Tables XXIII and XXV (averaging ·95 and ·94 respectively), although approximating so closely to unity, are somewhat disturbed by any large specific factors which are common to certain pairs of the qualities, and which therefore impose additional correlation over and above that arising from the general factor; e.g. there is a large specific factor common to 'trustworthiness' and 'conscientiousness' in both sets of results. Indeed, such disturbance would be far greater were it not for the large mean variations of values in the columns, owing to the presence of the minus values. The reason that the boys' results reach so high an average as ·95 in Table XXIII without the elimination of '*g*' is to be found in the smallness of the correlations between '*g*' and these eight qualities.

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The nature of our general factor must obviously be sought in these four headings, and any hypothesis as to this must cover all of them. Many people would, perhaps, at once select our first heading (moral qualities and the deeper social virtues) as being the most comprehensive and radical, but it is difficult to think of these as covering *all* the others. The group (2) persistence of motives indicates our general factor just as strongly, and persistence might equally apply to immoral and anti-social purposes. But the possibility suggests itself of reversing the explanation and of deducing, instead, the moral and social virtues from those of persistence, and this view is encouraged by the observation that our remaining groups (instability of the emotions, and the lighter side of sociality) may be regarded as being, in some degree, negative aspects of persistence of motives. For the persistence of a motive in consciousness, and its power to appear in consciousness at any time, even when the field of ideas occupying consciousness at the moment is little, if at all, related to it, seems quite reasonably to be at the base of moral qualities. Trustworthiness, conscientiousness, kindness on principle, fair-play, reliability in friendship, etc. are lessons derived from social education. These lessons will be learnt more effectively in proportion as they persist long and recur readily.

Further, this theory—that of regarding all these qualities as being in some functional relation to 'persistence of motives'—seems to be in good accordance with the system of relations we have shown to be exhibited by the two aspects of intelligence. For 'profound' intelligence, as distinguished from mere 'quickness,' may be regarded as being a steadier and more stable grasp of the mental content. (One of the prefects reported that he understood 'profoundness' to mean "The grasping of an idea fully, turning it over, and viewing it from every point of view"—see No. 36, Appendix II.)

We therefore venture to suggest (tentatively and with much desire for further evidence) that the nature of the second factor, whose generality would appear to extend so widely in character, is in some close relation to 'persistence of motives.' This conception may be understood to mean *consistency of action resulting from deliberate volition, or will.* (For convenience, we shall in future represent the general factor by the symbol '*w*'.)

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### 5. EXAMINATION OF THE LITERATURE OF CHARACTER-STUDY IN THE LIGHT OF THIS SUGGESTION.

The literature of character-study is so abundant that it ought to supply some material bearing upon the present argument. It is true that no generality, however frequently asserted, has ever been demonstrated, but still there should at least be much observational or descriptive data corroborating our general factor, and our theory that its nature is closely related to 'persistence.'

(1) *G. E. Müller and A. Pilzecker.* (*Experimentelle Beiträge zur Lehre vom Gedächtniss*, Leipzig, 1900.) These authors, in their valuable experimental work on memory—carefully observed and studied with nonsense-syllables—make several observations as to the nature of the 'perseveration-tendency' which they define as a tendency which every idea has, after once being in consciousness, "to remount freely into consciousness." This tendency is studied by them exclusively as an aspect of memory, is sharply distinguished from association of ideas, and is shown to differ greatly in different persons. They make a few casual observations suggesting an extension of the tendency to further processes, and later they suggest its further possible extension to character.

Viewed in the light of the present work, the generality which they thus imply for the 'perseveration-tendency' might possibly be the generality which we have found in our estimates of character-qualities.

(2) *G. Heymans and E. Wiersma*, whose work has already been briefly reviewed (Chap. I, Section 3), furnish material which, on examination, supplies very complete observational corroboration to *our* result. To quote one 'sample' of their observations ('Eine Stichprobe—Geizige und Verschwender,' 5th article, *Beiträge zur speciellen Psychologie*, p. 436):

| | Avaricious | Spendthrift |
|---|---|---|
| 1. | Men of principle. | Not so. |
| 2. | Not emotional. | Emotional. |
| 3. | Depressed and gloomy. | More cheerful and lively. |
| 4. | Anxious and serious. | Irresponsible. |
| 5. | Hard to appease. | Easily appeased. |
| 6. | Adheres to his once formed opinion. | |
| 7. | Men of habit. | Change loving. |
| 8. | Work for a far-off goal. | Work for an immediate result. |
| 9. | Answer questions in a provisional manner. | Answer positively. |
| 10. | Mathematical talent. | No mathematical talent. |
| 11. | No artistic ability. | Talent for music, drawing, authorship, dramatic art. |

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| | Avaricious | Spendthrift |
|---|---|---|
| 12. | Not witty. | Witty. |
| 13. | Quiet and reserved. | Not so. |
| 14. | Not given to telling anecdotes. | Given to telling anecdotes. |
| 15. | Does not speak much in public. | Fond of speaking in public. |
| 16. | Never in debt. | Often in debt. |
| 17. | Not easy to manage. | Easy to manage. |
| 18. | Brings up his children strictly. | Allows much freedom. |
| 19. | Conservative. | Radical. |
| 20. | Hermit-like. | Pleasure-loving. |
| 21. | Not a sophist. | A sophist. |
| 22. | Not sport-loving. | Sport-loving. |
| 23. | Interested in finding out the means of others. | Not so interested. |
| 24. | Morose. | Complimentary. |
| 25. | Dignified and precise. | Ironical. |
| 26. | Slow and short in speech. | Loud in speech. |
| 27. | Seldom or never laughs. | Laughs much. |

From the examination of such comparisons of which this is a sample, these writers infer a threefold classification of temperaments, based upon (1) the emotions, (2) activity, (3) primary and secondary functions, and the 'secondary function' seems to coincide with Müller's 'perseveration.'

Considering the above qualities in the light of our own work, it is remarkable how completely they are represented in the group from which we derived our general factor.

(*a*) Our Nos. 18, 20 and 21 (kindness on principle, trustworthiness, and conscientiousness) would include Nos. 1, 4, 16, 18, 21 in their list.

(*b*) Our Nos. 32, 33 and 34 (remote purpose, absence of changeability, and perseverance) would include Nos. 5, 6, 7, 8, 13, 17, 19 and 20 in their list.

(*c*) Our No. 2 (instability of emotions, as opposed to permanence of mood) would include Nos. 2, 3, 4, 25, 26 and 27 above.

(*d*) Our No. 11 (eagerness for admiration) would include Nos. 9, 11, 12, 14, 15, 21, 24, 26, 27 above.

(*e*) Our No. 31 (bodily activity in pursuit of pleasure) would include Nos. 7, 20 and 22 above.

There is, of course, some overlapping, e.g. we have placed their Nos. 26 and 27 under both our No. 2 and No. 11. Only "mathematical talent" (10) and "Interested in finding out the means of others" (23) are thus omitted; the former is largely, if not entirely, intellectual; the latter is not so much a quality as an effect of the other qualities.

It would therefore appear that not three, but one factor is general; we are again tempted to identify our own factor ('*w*') with their

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'secondary function,' and if that is true the other two (emotions and activity) are not generalities at all.

(3) *Dr Otto Gross* (*Die Cerebrale Sekundärfunktion*, Leipzig, 1902), though he states that he is "on purely speculative ground," also elaborates the theory of the secondary function as being the basis of "a useful schematising of many psychological postulates," and many of the observations of

(4) *E. Meumann*, described under a variety of titles, are also included in the one '*w*,' our general factor.

(5) *G. E. Partridge* (*An Outline of Individual Study*, 1910) gives an account of a detailed study of two boys (twins) who resembled each other so closely that neighbours who had known them all their lives could not distinguish them. More careful observation and experiment, however, revealed striking differences of character between them, and these are described in full in the text. A synopsis of the differences (using Partridge's own words) is given:

| Harold | Earl |
|---|---|
| More control of voluntary movement. | In free movement quicker, showing impatience and lack of control. |
| Industrious—more patient and persistent in performing tasks. | Restless and animated in school, given to idle occupations. More easily distracted. |
| | More competitive spirit. |
| More helpful—dependable—regular in his expenditure of energy and in application of effort. | Has periods of feverish activity, alternating with periods of listlessness. |
| Always willing to try, but never expected to do *very* well. | Great enthusiasm in attempting a new task but enthusiasm soon exhausted. |
| More moral, good-natured, polite, keen to do work well. | More sunny and laughing, was a tease. |
| At times sensitive and morose. | |
| Less self-confidence. | Bolder in social relations, always acted as spokesman. |
| More sympathetic and generous. | More often acted apparently to show off. |
| More conscientious in his work. | Impatient of detail. |
| More genuinely pleased at praise. | |
| Neat and careful writing. | Careless, hasty and irregular work in copy books. |
| Superior in literal memory, both when tested after a year, and after 5 minutes' study. | Superior in rapidity of complex mental processes. |
| Association reactions showed more clear and more stable mental imagery, and perhaps less in quality. | Reactions much less uniform—a more variable mental process; more frequently caused by recent experiences and objects in the immediate environment. |

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"It was concluded (from the experiments and from subsequent introspections on the part of the two boys) that Earl's mental content changed more rapidly than Harold's, and that images were more complex, but less clear."

Partridge remarks that "the differences that were discovered do not seem to be entirely unrelated, but in many cases *to be dependent upon one another* or to be off-shoots from the same stem" (the italics are ours). It must have been evident to anyone comparing this list of differences between the two boys with our own list, from which we deduced our '*w*' (see Tables XXI *et seq.*), that Partridge's observations supply another very close descriptive corroboration of our theory.

(6) *Dr Carl Rath* (*Über die Vererbung von Dispositionen zum Verbrechen*, Stuttgart, 1914) gives an interesting description (p. 130) of a person under his observation which we may quote as furnishing a good example of marked defect in respect to our '*w*'—(the translation is ours).

"A characteristic example in Criminal Psychology may be here quoted. G—, sprung from a respectable family, was as a boy gifted with strong imagination. In sport he was always extremely active, on the other hand his progress in school was rather slow. In lessons he did nothing right—to sit still and to work were things to which he could not get accustomed. He is now an impostor and a swindler, frequently sentenced to prison, and finally to eight years in a House of Correction. He likes to appear in the uniform of an Officer of Dragoons—to play the 'fine gentleman,' and when it is his turn to pay the reckoning, to abscond. He prefers to read romances in which the life of the upper classes is portrayed—and among the inhabitants of the Reformatory, he is called 'Count G.'

"He says himself, that on his discharge he will go back to his old life as a swindler. In reply to the remonstrance that an hour of pleasure would cost so long and hard a punishment, that he could never be free from anxiety about detection, that each moment he would be fearful of arrest and imprisonment, he answers, 'As soon as I don my uniform I forget all dangers which may threaten me—I am then another man. No thought arises in my mind that I may be in danger; then are forgotten the long years of imprisonment and deprivation; such hours I feel to be beautiful and not too dearly bought at any price.'"

(7) *A. J. Culler* ('Interference and Adaptability,' *Archives of Psychology*, July, 1912) puts forward the proposition that the general character of mental development may be described under two factors, interference and adaptation. He bases his remarks upon the observation of a small number of subjects and upon 'graded estimates' of

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qualities somewhat like our own, and says "The question of adaptability was found to have wide practical interests, racial, political, religious, social and industrial.....Observation shows that in all these fields adjustments are made with greater or less ease among individuals and groups. The friction which opposes these adjustments, or in a more general sense adaptation, is interference. Interference seems to be present to a greater or less extent among all these adjustments."

Culler's observations seem to furnish yet another suggestion as to the nature of our '*w*,' our 'persistence of motives' would seem to correspond with his 'interference'—the friction that opposes and delays adjustments.

(8) We may illustrate further by a reference to work at University College, London. As far back as February 1909, the following exercise was proposed to a Seminar Class:

> Here lies our sovereign lord and king,
> Whose word no man relies on;
> Who never said a foolish thing,
> And never did a wise one.

"How does psychology, especially pathological and experimental, throw light on such combinations of social brilliance with deficient judgment and unsound principle[1]?"

The question may appropriately be applied to the present investigation. Such combinations of qualities as described here indicate a defect in our general factor 'persistence.' The widely ramifying influence which it exerts may be further illustrated by considering two extreme cases, Isaac Newton (strongly marked 'persistence') and Francis Bacon (deficient in 'persistence').

| | *Newton* | *Bacon* |
|---|---|---|
| *Imagination.* | Worked doggedly and persistently at a comparatively small region of scientific thought. | Explored the whole universe and was always 'brilliant.' |
| *Intellect.* | Thorough; made actual discoveries in optics and mathematics. | Made brilliant suggestions—struck out many new paths but never quite the first. |
| *Flexibility.* | Read very little mathematics, did his work his own way. | Essentially a time-server. |
| *Moral Principle.* | Was the soul of uprightness and a reliable friend. Prudent and saving. | A spendthrift. |
| *Emotions.* | Sensitive and retiring. Shunned the publication of his work. | Loved the 'limelight.' |
| *Practicality.* | Hated business and pursued the work of a politician on principle only. | Delighted in practical affairs and shrewd in details. |

[1] I am indebted to Prof. Spearman for permission to quote this.



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(The comparison also furnishes a good illustration of the fact that the new factor—persistence—is independent of '*g*'—both men were highly intellectual.)

(9) *N. Ach* (*Über den Willensakt und das Temperament*, 1910). This book contains a recent and important attempt to classify temperaments. The classification is based upon the activity of the will. The author distinguishes between (*a*) the phenomenological side of the act of will and (*b*) the dynamic side, and under the latter he examines, among other things, the play of perseveration upon the 'determining-tendency.' Just as Müller, while investigating memory, is at some pains to distinguish perseveration from association, now Ach is at similar pains to distinguish it, even in the form of perseverating 'determining-tendencies,' from the activity of the 'will.'

There are thus, in the literature we have referred to, three distinct conceptions (*a*) 'will,' as conceived by Ach, (*b*) perseverating determining-tendencies, (*c*) further perseveration, as of ideas, sensations, movements, etc.

Müller, Heymans and O. Gross would appear to regard all three as one and the same functional unity. Ach, on the other hand, makes 'will' independent and fundamental; and he apparently makes no distinction between perseverating determining-tendencies (*b*), and perseveration of ideas, etc. (*c*); none of them, however, give much definite evidence of any of these generalities.

Our own position—that the general factor '*w*' shown to exist in our data is in some relation to 'persistence of motives'—agrees, perhaps, best with Ach's 'will.' But there is no proof here as to whether or not this coincides with perseverating determining-tendencies (*b*), still less as to whether it coincides with perseveration of ideas, etc. (*c*), or indeed as to whether (*b*) and (*c*) are generalities at all.

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# CHAPTER VI

## CONSIDERATION OF THE ERRORS INVOLVED IN ESTIMATES OF CHARACTER-QUALITIES

1. *Random errors.*
2. *Systematic errors (A). Those due to a common bias in the minds of all the observers.*
3. *Systematic errors (B). Those due to observers taking different points of view.*
4. *Systematic errors (C). Other irrelevant factors.*

In considering the report of our work up to this point, grave and serious doubts will probably have arisen with regard to the many possible sources of error to which 'estimates,' as we have collected them, are liable. There is first the difficulty of forming such estimates at all; conspicuous examples which have been pointed out are No. 8—'sense of humour,' this quality being capable of interpretation in meaning through a wide range, from mere horseplay at one end to the finest display of subtle wit at the other; similarly No. 22—'religion'; the objection has been raised that some judges, in assessing men like Maeterlinck or Bradlaugh, might honestly mark them + 3, while other equally honest judges would mark them − 3. Secondly, there is the difficulty, even the impossibility, of agreeing upon standards. When, for instance, one asks, does intelligence begin to deserve the title of 'quick' or 'profound,' and who can say of anyone that he is 'conscientious' and 'pure-minded'? And with such strong suspicions that our original observations may contain so many errors, it has been declared "a great strain upon our belief that mathematics is going to put these errors all right."



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In order to evaluate these objections it is absolutely necessary to distinguish clearly between

1. The errors in the original estimates.
2. The effects of these errors on the inter-correlations between the estimates.
3. Their effect on correlations between columns of the inter-correlations.

With regard to the original estimates, no absolute standards were attempted. The observations were all confined to comparisons between one person and another, and even then the distinction of 'more' or 'less' of a quality was limited to a very broad classification (our seven classes). And the difficulty of estimating thus should not be exaggerated. We all can and do form such estimates frequently under infinitely less favourable conditions than those of the present investigation—our personal adaptation to the social environment depends largely upon our ability to do this. In ordinary life, for instance, we meet a stranger at dinner, and after an hour's conversation we have made more or less decided judgments of him with reference to many qualities, such as candour, discretion, personal vanity, tact, humour, even honesty and conscientiousness. These 'first impressions' are very frequently, though not always, confirmed by subsequent further acquaintance. Our judges on the other hand were definitely and deliberately keeping their subjects under close daily observation for six months with the express purpose of making such estimates to the best of their ability. Further, the stranger we met at dinner is very probably aware that he is 'making an impression,' our subjects were utterly ignorant of the fact that they were under observation at all. Still, putting aside the question of exaggeration, there must be errors, and these are large as compared with measurements of material things. We must carefully examine all the possible sources of error, and also their influence on the present results. The errors will be either *random* or *systematic*. We will deal first with the random errors.

### 1. Random errors.

Even if judges A and B are in all other respects perfectly equipped to make their estimates of the same 20 subjects, it is highly improbable that they will return exactly similar gradings. But the general size of the random errors thus produced can be estimated quantitatively. For they must introduce discrepancies between two different estimates, and the amount of discrepancy, i.e. the general size of their random

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error, can be measured by correlation. This precaution has been taken (see reliability-coefficients). Many investigations are much reduced in value by the neglect of this. Our results show that, though some pairs of estimates prove quite useless for want of reliability, yet 87 per cent. of them are of sufficiently high reliability to warrant our proceeding with the work—the average reliability of all the pairs retained being ·55 (see also Chap. III, Section 2)[1].

Now let us take our three points *seriatim*. It is true that we cannot correct the original observations. But as regards No. 2—the inter-correlations between the estimates—our reliability-coefficients give us a means of correcting these for the attenuation due to the presence of these random errors, the 'corrected' coefficients of Tables VI and VII being the inter-correlations which would exist if we had pooled the estimates of an infinite number of judges whose average correctness was the same as that of the two judges actually employed. And as regards No. 3—the correlations between columns of inter-correlations—the effect of random errors upon these does not constitute any bias (as, for example, attenuation[2] does). Hence they can never account for any of the previously given results, as these all consist, on the contrary, of regularities. They could neither produce nor destroy such a result as is produced by the present method (i.e. the $R'_{ab}$ being practically equal to unity throughout). We may yet be asked what effect the correction of the inter-correlations for attenuation has upon the correlations between columns. This also can be shown to have no regular effect upon the $R'_{ab}$.[3]

Hence, generally, whatever random errors exist in the original observations, their effect upon the inter-correlations is reduced to a minimum by our correction for attenuation, and they have no effect on the correlations between columns of inter-correlations. Thus the results of our enquiry represent conclusions which, though based upon observations which contain random errors, are not vitiated by their presence.

Let us now deal with the systematic errors occurring in the original observations.

[1] They also serve the purpose of giving us a measure of the 'probable error' of the estimates.

[2] They therefore require and receive no correction. The corrections of $R_{ab}$ are solely for the errors of sampling—the 'probable errors' (and these are governed entirely by the number of cases)—not for any errors of observation.

[3] The proof is given in Appendix I, p. 81.

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### 2. Systematic errors (A). Those due to a common bias in the minds of all the observers.

That such errors exist there can be no possible doubt—we shall even be able to demonstrate their existence and determine their nature. But we must first point out that errors of this kind cannot affect a single numerical value throughout our work—estimates, inter-correlations, or correlations between columns. What they do affect is the *interpretation* placed upon these, i.e. any such common bias has a direct bearing upon the nature of the qualities really estimated. Our material furnishes us with certain means of checking the interpretations. (1) We have our collected information as to what the several judges really understood by the various qualities as named in the schedules—see Appendix II, also Chap. II, Section 3. (2) We can examine the relation of any inter-correlation between two qualities to all the other coefficients for the two qualities and (3) we can compare results obtained from 'estimates' with those obtained, for the same subjects, from objective measurements—the latter being, of course, quite free from any such bias. Let us suppose, for instance, that the observers, in estimating the intelligence qualities (Nos. 35 to 38 in men's schedules), are biased in the direction of marking subjects who possess other desirable qualities too highly, and vice versa. We can turn to our objective criteria of the intelligence of the same subjects, which we possess both in our experimental measurement of '*g*' and in the examination results. Any qualities in our Tables VI and VII which give significantly different correlations with the latter from those they give with the estimates are at once under suspicion of constituting such a common bias in the estimates. And this we have shown to be the case for 'sense of humour' (No. 8) and for our group of the 'persistence' qualities (see Tables XXII to XXV), and the further procedure by means of partial correlation confirms the suspicion (see Chapter IV, Section 7). We consequently obtained what has been called 'spurious' correlation between 'sense of humour' (No. 8) and the intelligence-qualities. But the word 'spurious' is quite misleading in this use. The correlation coefficients do no more than they can be expected to do, viz. reflect the facts contained in the data; but they cannot interpret their own meaning. If we said that the high figure obtained, for instance, between 'humour' and 'quickness of apprehension' (+ ·85) was due to a large degree of common nature between the two qualities, we should be guilty of a spurious interpretation of the coefficient obtained. But the coefficient itself is not spurious or false in any way, it quite unequivocally states that the estimates of (sense of humour + the common bias

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in favour of intelligence) correlate + ·85 with the estimates of 'quickness of apprehension.' It is a main feature of the mathematics now in use (chiefly due to Spearman and Udny Yule) that it places the importance not upon the individual coefficient but upon the interpretation of it in the light of its relations to other coefficients. It becomes evident that if our list of qualities is sufficiently wide to include all the qualities that can have a general and fundamental bearing upon the total personality, then our procedure is capable of detecting any and every common bias that may exist. This detection was materially helped, in the case of intelligence, by our possession of an exact *objective* measurement (the '$g$').

A further consideration of the nature of a common bias shows that its effect upon our main argument is to widen the generality which we have demonstrated by $R'$ being shown equal to 1 for our Tables XXIII–XXV. For suppose that in estimating any quality $x$ our twenty observers actually estimated $x + a$, where $a$ represents the added consideration traceable to the common bias, then, if the $R'_{xy}$ is still, as it has been shown to be, practically equal to unity throughout, the general factor so demonstrated thereby *only becomes more general*, i.e. the '$w$' which dominates our eight qualities of those tables is also responsible mainly for the $a$.

There is, however, another point of view which has been put forward concerning the validity of conclusions based upon such estimates as ours. The error shown to affect the judgments of intelligence by a common bias in favour of 'humour' may have a very wide application. This bias is due to a popular prejudice which attaches quick intelligence to a sense of humour—and we have shown that the prejudice is groundless. In the same way, it has been urged, every popular illusion may be lurking in, and even dominate, our correlations. But a little reflection shows that this cannot be the case. It is quite easy and natural to take humour as a readily available symptom of intelligence; but for other instances it would seem most improbable and unnatural to take one quality as the criterion of another. No one would, for example, rationally regard perseverance in a course of conduct as a sign of conscientiousness, or want of trustworthiness as a sign of eagerness for admiration or of readiness to become angry. Hence it is clear that any correlation thus superimposed by such bias would necessarily be irregularly distributed from one correlation to another, and therefore $R'$ could not approximate to unity. But it actually does so in the qualities concerned in our '$w$' (Tables XXIII–XXV). Therefore in these

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qualities, at any rate, the suspected indirect diagnosis cannot have occurred.

### 3. Systematic errors (B). Those due to observers taking different points of view.

Let us now examine the influence which would be exerted if different points of view existed in the minds of the observers.

The precaution we took of asking them to report as to what they really understood by these qualities when assessing their subjects (see Appendix II) applies to this source of error also—any disturbance of this kind can be detected, estimated, and allowed for. We will consider the statistical effects step by step.

(*a*) Take first the uncorrected correlations between the qualities (the $r_{xy}$'s of Tables IV and V). Suppose that two observers, in estimating any quality $x$, really estimate $(x + a)$ and $(x + b)$, the $a$ and $b$ being due to their different points of view. Such added consideration would reduce the amount of the coefficient obtained, but it would hold good for whatever the estimates have in common.

(*b*) Next consider the corrected correlations (the $r'_{xy}$'s of Tables VI and VII). If the $a$ and $b$ are uncorrelated with the true elements, the above reduction is compensated for by the correction and the true result reached. If the two added elements $a$ and $b$ are correlated with any of the true elements, the meaning of the coefficient becomes much more obscure and complex in character, and very complicated further corrections might be necessary to reduce it to a clear, useful meaning[1].

(*c*) Then comes the effect on $R'_{xy}$. We need only consider the simpler case of $R'_{xy}$ based on uncorrected coefficients, since, as we have seen, the correction of $r_{xy}$ does not affect the $R'_{xy}$. If the $a$ and $b$ are uncorrelated with any of the other qualities, then (whether or not correlated with the true elements) they resemble the random errors, in that they produce no general effect on $R'_{xy}$. Next suppose that the $a$ and $b$ do correlate with some of the other qualities. This would disturb the $R'_{xy}$ in an irregular manner, and such disturbance would preclude its having unity as its value. But in our Tables XXIII–XXV, referring to the 'persistence' group of qualities, it has been shown equal to 1, therefore such disturbances do not occur.

[1] See Spearman, 'Der Beobachtungsfehler in der Korrelationslehre,' *Zeitsch. f. angew. Psych.* 1912.

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### 4. SYSTEMATIC ERRORS (C). OTHER IRRELEVANT FACTORS.

Dr Brown, in criticism of the theory of '*g*,' says, "There is also the danger that community of external influence, heterogeneity of material, and other 'irrelevant' factors may superimpose 'spurious' correlation upon the results, thus emphasizing the general causes of correlation as compared with the specific[1]." The criticism, if valid, applies equally to our theory of a second general factor '*w*.'

'Relevant' and 'irrelevant' are arbitrary terms, and we may well ask, 'irrelevant to *what*?' The objection concerning external influences has no force until the '*g*' (or the '*w*') has been asserted *not* to be due to external influences. This had not, up to then, been done.

Further, the passage quoted implies *something* to which the external influences, etc., are irrelevant, and *some* general causes of correlation upon which the 'spurious' correlation is superimposed. But in these cases there cannot be two such sets of circumstances, the one relevant and the other irrelevant (excepting, of course, two sets completely correlating with one another and forming one complex set), producing the correlation in the results. If this were so, the distribution would not be 'unifocal' but 'multifocal' and then $R'_{xy}$ would not be equal to 1.

This suggests the possibility of the following inference which appears to be of interest. The evidence seems strongly to indicate that the '*w*' is, at least in part, a fundamental, organic unity. Hence let us suppose a fundamental '*w*,' which is partly responsible for the correlations, and also suppose that further influences of a more superficial kind had superimposed correlation upon that due to the '*w*,' by acting in the same direction (but not acting *on* '*w*'). We should then have two or more factors, appreciably independent[2] of each other, and in this case $R'_{xy}$ could not equal unity. But it has been shown to do so, for both groups of students and independently for the group of schoolboys. Therefore the "further influences" can have produced no appreciable effect superimposed upon the '*w*,' and the latter must be almost wholly responsible for all the correlations from which we obtained a unity value for $R'_{xy}$. (And precisely the same argument would hold good for the '*g*' also.)

[1] Dr W. Brown, 'The Effects of "Observational Errors" and other Factors upon Correlation Coefficients in Psychology,' *B. J. P.* VI. 1913.

[2] Of course, if the effect of the external influence were not superimposed on that of '*w*,' but acted directly upon '*w*,' it would not be detectable by this criterion, for $R'$ would continue to yield unity value.

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Further, just as it is impossible, so long as $R' = 1$, that any fallacious general influence should be superimposed upon the true one, so also there cannot possibly exist two or more such fallacious influences—even in the extreme case of *no* true one being present. Thus the alleged danger of "several other irrelevant factors" is out of the question altogether.

We have now examined all the sources of error, random and systematic; and also their effect upon the successive steps of the mathematical argument we have used. To sum up:

(1) We possess a check upon the estimates in the material summarised in Appendix II—the reports of the observers as to what they understood by the terms used.

(2) A large proportion of the alleged errors have been shown not to exist.

(3) Many of the existing ones have been discovered and thus turned to advantage.

(4) Above all, *the present argument* is not of a character to be vitiated even by the undiscovered errors; it has not attempted to do anything like what has been called "putting all these errors right," and the conclusions therefore should put no "great strain on our belief."

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# CHAPTER VII

## GENERAL SURVEY OF THE WORK AND ITS RESULTS

1. (*a*) Speculative writing on the subject of character has been very extensive; scientific evidence very meagre. The writer's position, in touch with a large homogeneous group of students and also with several schools, and with prefects, teachers, and others available both able and willing to work under his direction, furnished an unusually favourable opportunity for a systematic investigation.

(*b*) Estimates of many qualities were obtained and also certain objective criteria of intelligence. The methods of correlational mathematics, and particularly the recent valuable applications to psychological purposes due to Professor Spearman, were used.

(*c*) The investigation returned such an abundant harvest of results that it became necessary to limit the present report to certain broad features of character in general. It is apparent, however, that the material could be profitably examined in further detail—each quality is shown in its relations to all the others, and consequently a study of any one quality is assisted.

2. In order to relate our own work with the larger volume of experimental psychology which already exists on the side of intelligence, we made a parallel investigation of the theory of '*g*' with the same subjects.

(*a*) Our work completely confirms this theory.

(*b*) It throws light upon the nature of estimates of 'General Intelligence,' as supplied by teachers and others. These have been shown to be not pure measures of the intelligence proper (as the '*g*' is), but to be biased in various manners and in varying degrees for different judges, in favour of individuals who possess other desirable (or criterial) qualities besides the actual intelligence in question.

(*c*) This fact throws emphasis upon the purity of '*g*' as a measure of intellective energy. It measures this and this only—a person's 'index

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of intellective energy' being thus just such an abstraction as other abstractions in physical science.

(*d*) When the purity of '*g*' as a mental measurement is realised, certain misconceptions and difficulties which, in the minds of some, have hindered the acceptance of the theory disappear.

3. Turning now to our main thesis, we have been able to demonstrate the existence of a second factor exerting a widely-ramifying influence on the side of character.

(*a*) Its generality has been demonstrated.

(*b*) It markedly dominates all the correlations yielded by the estimates of moral qualities, the deeper social virtues, perseverance and persistence; also, on the negative side, qualities related to instability of the emotions and the lighter side of sociality.

(*c*) *Its nature is best conceived,* in the light of our present evidence, *to be in some close relation to 'persistence of motives'; i.e. to depend upon the consistency of action resulting from deliberate volition, i.e. from will.* It thus appears to coincide more with Ach's conception of will than with either 'perseveration' or the 'secondary function.' Further evidence is necessary.

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# APPENDIX I

## SYNOPSIS OF MATHEMATICAL FORMULAE, ETC., UTILISED IN THE TEXT

If a number of individuals are measured for any capacity or quality, we obtain a series of values: $a_1$, $a_2$, $a_3$ ... etc.

If the same individuals are measured again for the same capacity or quality, we obtain a second series of values: $a_1'$, $a_2'$, $a_3'$ ... etc.; and so on.

Similarly, if the same individuals are measured for some other capacity or quality, we obtain series of values: $b_1$, $b_2$, $b_3$ ... etc.; $b_1'$, $b_2'$, $b_3'$ ... etc.; and so on.

The mathematics of Statistics (known as the Theory of Variables) furnishes powerful means of controlling the interpretation of such series of obtained values.

The relevant propositions are herein stated—reference is given to various works for proofs, sources, etc.

1. A series of $n$ values of a variable possesses an average or *mean* value ($\overline{X}$), the arithmetic mean of the values;

$$\overline{X} = \frac{X_1 + X_2 + X_3 + \ldots + X_n}{n};$$

which may be written

$$= \frac{\Sigma(X)}{n} \quad \ldots\ldots\ldots\ldots\ldots\ldots (I).$$

2. The 'measure of dispersion' of a series of $n$ values of a variable is known as the *Standard Deviation* (denoted by $\sigma$).

If $x_1$, $x_2$, $x_3$ etc. denote the deviations of the separate values of $X_1$, $X_2$, $X_3$ etc., from the mean ($\overline{X}$), then

$$\sigma^2 = \frac{\Sigma(x^2)}{n} \quad \ldots\ldots\ldots\ldots\ldots\ldots (II).$$

3. *Coefficient of Correlation*—a measure of the degree in which high (or low) values of one series show any tendency to be associated with high (or low) values of another series.

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With the same notation as above, the coefficient of correlation (denoted by $r$) is given by

$$r = \frac{\Sigma(xy)}{n\sigma_x\sigma_y} \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(III)}.$$

This is known as the 'product-moment formula.'

The quantity $r$:

(1) is a pure number,

(2) its value is unaffected by the scales in which $X$ and $Y$ are measured,

(3) varies in value from + 1 where there is perfect correlation, to − 1 where there is perfect inverse correlation.

[For details see, among other works, G. Udny Yule, *An Introduction to the Theory of Statistics*, pp. 174 *et seq.*]

*Note.* If, as is done throughout the present work, the assessments are made by means of 'marks' which cluster equally above and below a zero value for the average cases, formula (III) simplifies to

$$r = \frac{\Sigma(xy)}{\Sigma(x^2)} = \frac{\Sigma(xy)}{\Sigma(y^2)}, \text{ for } \sigma_x^2 = \sigma_y^2 = \frac{\Sigma(x^2)}{n} = \frac{\Sigma(y^2)}{n};$$

$$\therefore\ n\sigma_x\sigma_y = \Sigma(x^2) \text{ or } \Sigma(y^2).$$

4. The calculations involved in formulae (II) and (III) may, in many cases, be considerably simplified if the series are replaced by their order of merit or put into 'ranks,' as it is usually called (i.e. the highest value of the series marked 1, the next highest 2, and so on). In this case the values of $X$ and $Y$ are the natural numbers 1 to $n$. The mean is then $\left(\frac{n+1}{2}\right)$, and $\Sigma(x^2)$ = twice the sum of the squares of the first $\left(\frac{n-1}{2}\right)$ natural numbers. Thus

$$\sigma_x^2 = \sigma_y^2 = \frac{n^2-1}{12},$$

and

$$r' = 1 - \frac{6\Sigma(d^2)}{n(n^2-1)} \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(IV)},$$

where $\Sigma(d^2)$ = the sum of the squares of the differences between each value of $X$ and the corresponding value of $Y$.

This is known as the "*formula for 'ranks.'*"

(C. Spearman, 'The Proof and Measurement of Association between Two Things,' *Amer. J. Psych.* xv. 1904.)

If the distribution is normal (see p. 18) it has been shown that this replacement of the measurements by their 'ranks' can be effected

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without any appreciable change in the correlational coefficient, since

$$r = 2 \sin\left(\frac{\pi}{6} r'\right)$$

(Karl Pearson, *Drapers' Company Research Memoirs*, Biometric Series IV. 1907) and this $= r'$ with a maximum difference of ·02 (where $r$ denotes coefficient calculated for measurements, and $r'$ denotes coefficient calculated for 'ranks').

5. Instead of formula (IV) we may use a simpler one still in all cases where an *approximately* true value for the coefficients is sufficient for the purpose of the psychological argument involved. It is known as Spearman's 'Footrule' (*Brit. J. Psych.* II. 1906), and is given by

$$\left.\begin{aligned} R &= 1 - \frac{3\Sigma(d)}{(n^2-1)} \\ r &= \sin\left(\frac{\pi}{2} R\right) \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots (V)$$

(where $d$ = the (unsquared) difference between each value of $X$ and the corresponding value of $Y$).

6. *Correlation between pools.* If two values of $v$ are pooled, and also two values of $w$, and the values obtained are denoted by $V$ and $W$, then

$$\sigma_V^2 = \sigma_{v_1}^2 + \sigma_{v_2}^2 + 2r_{v_1 v_2}\sigma_{v_1}\sigma_{v_2},$$

and (if $\sigma_{v_1} = \sigma_{v_2}$) this $= 2\sigma_v^2(1 + r_{v_1 v_2})$.

Similarly $\sigma_W^2 = 2\sigma_w^2(1 + r_{w_1 w_2})$.

Hence $n\sigma_V\sigma_W = n\sigma_v\sigma_w \cdot 2\sqrt{1 + r_{v_1 v_2}}\sqrt{1 + r_{w_1 w_2}}$.

(See also Yule, *Introd. to the Theory of Statistics*, p. 208.)

7. *Probable Error*—measures the error to which an average value (or a coefficient of correlation) is liable in consequence of what is known as "the fluctuations of random sampling." It is a measure of the unreliability of statistical results as far as they arise from this random sampling, and the term 'probable' (not a very happy expression for it) is meant to indicate that in the case of normal distribution this 'error' is a quantity such that we may expect errors of sampling greater or less than it with about equal frequency.

The p.e. of an arithmetic mean

$$= \frac{0{\cdot}6745\sigma}{\sqrt{n}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (VI).$$

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The p.e. of a correlation coefficient calculated by Formula (III)

$$= \frac{0{\cdot}6745\,(1-r^2)}{\sqrt{n}} \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(VII)}.$$

The p.e. of a correlation coefficient calculated by Formula (IV)

$$= \frac{0{\cdot}7063\,(1-r^2)}{\sqrt{n}} \quad \ldots\ldots\ldots\ldots \text{(VIII)}.$$

8. *Reliability Coefficients.* If we have two series of values for the *same* variable, the coefficient (calculated by any of the methods given) between these is a measure of the 'reliability' of the measurements of this variable.

Thus, if $x_1$, $x_2$ represent two series of values for a variable $x$, and $y_1$, $y_2$ represent two series of values for a variable $y$, the reliability of $x$ is the correlation between $x_1$ and $x_2$ (written $r_{x_1x_2}$) and of $y$ is $r_{y_1y_2}$.

If we have more than two such series, the average value of the correlations between the various $x$'s (and $y$'s), taken in pairs, gives the reliability of $x$ (and $y$), written $\bar{r}_{x_1x_1}$ and $\bar{r}_{y_1y_1}$.

Such reliability coefficients are of great value in dealing with the vitiation of correlation coefficients by errors in the series of measurements upon which they are based. The effect of *these* errors must be clearly distinguished from that of sampling fluctuations. The 'probable error' measures the latter alone, and gives no indication of the former. The errors in the measurements may be

(1) *regular* underlying variations in the measurements, such as increase of ability by practice, diminution by fatigue, a common bias, etc.

The influence of these must be eliminated by a careful grouping of the two or more series of measurements.

(2) Those due to '*accident*,' "superposed on the above regular variations, of such a discontinuously shifting sort that investigation, explanation, and control are almost baffled."

It is to eliminate these that the reliability coefficients are so useful. Thus for our two series $x_1$ and $x_2$ for $x$ with our other two series $y_1$ and $y_2$ for $y$, the *corrected* coefficient between $x$ and $y$ is given by

$$r_{xy} = r_{x_2y_2}\sqrt{\frac{1+r_{x_1x_2}}{2r_{x_1x_2}} \cdot \frac{1+r_{y_1y_2}}{2r_{y_1y_2}}} \quad \ldots\ldots\ldots \text{(IX)},$$

where $r_{x_2y_2}$ is the correlation between the average of the two series of measurements for $x$ and that for those of $y$.

Generally, if we have $p$ series of measurements for $x$ and $q$ series for $y$, the formula becomes

$$r_{xy} = r_{x_py_q}\sqrt{\frac{1+(p-1)\,\bar{r}_{x_1x_1}}{p\bar{r}_{x_1x_1}} \cdot \frac{1+(q-1)\,\bar{r}_{y_1y_1}}{q\bar{r}_{y_1y_1}}} \quad \ldots\ldots \text{(X)}.$$

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(Spearman, 'Correlation Calculated from Faulty Data,' *Brit. J. Psych.* III. 1910.)

9. *Partial or Multiple Correlation.* In many problems it becomes desirable to proceed from the correlation between two variables to those between more than two. Taking the simplest case (that for three variables, *a*, *b*, and *c*) we can determine, not only the *r* between them two at a time, but also that between any two of them on the assumption that the third variable remains constant. This is given by

$$r_{ab.c} = \frac{r_{ab} - r_{ac} \cdot r_{bc}}{\sqrt{1 - r^2_{ac}}\sqrt{1 - r^2_{bc}}} \quad \ldots\ldots\ldots\ldots (XI).$$

(Yule, *Proc. Roy. Soc.* Series A, 1907, p. 182, also *Introduction to the Theory of Statistics*, p. 235.)

[For the extension of this formula to more than three variables, see the work referred to.]

It has been found more convenient to state a few other propositions —of quite recent origin—in the text. References to original sources are given in each instance.

10. Proof that, in general, the correction of the inter-correlations for attenuation has no effect upon the correlation between columns (see p. 69).

(1) Consider first the case where $R = 1$, then $R' = 1$ and vice versa (see Spearman and Hart, *General Ability*, p. 66).

(2) If $R$ is less than 1,

(*a*) Apply first the correction for each column. No change is made in the correlation between them.

(*b*) Then apply the correction for each horizontal pair. The sole effect is to alter the relative weights of the pairs on the correlation. This alteration may equally well produce an increase or a decrease upon the $R'$:

Let $x_1, x_2, x_3 \ldots x_n$ and $y_1, y_2, y_3 \ldots y_n$ be the two columns, and let $a_1, a_2, a_3 \ldots a_n$ be the correction-factor for each horizontal pair.

Then the correlation between columns of uncorrected coefficients

$$\equiv r_{xy} = \frac{\Sigma (xy)}{\sqrt{\Sigma (x^2) \Sigma (y^2)}},$$

and then the correlation between columns of corrected coefficients

$$\equiv r_{(xa)(ya)} = \frac{\Sigma (xa)(ya)}{\sqrt{\Sigma (x^2a^2) \Sigma (y^2a^2)}}.$$



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Now $\Sigma(xa)(ya) = \Sigma(xy)a^2 = \Sigma(\overline{xy} + \delta)\Sigma(\overline{a^2} + \delta')$

(the bars signifying average values, and the $\delta$ and $\delta'$ the deviations of the several values of $xy$ and $a^2$ from the means $\overline{xy}$ and $\overline{a^2}$)

$$= \Sigma(xy) \cdot \frac{\Sigma(a^2)}{n}$$

(assuming that $a^2$ is independent of $xy$).

Similarly $$\Sigma(x^2a^2) = \Sigma(x^2) \cdot \frac{\Sigma(a^2)}{n}$$

(assuming that $a^2$ is independent of $x^2$ and of $y^2$) and

$$\Sigma(y^2a^2) = \Sigma(y^2) \cdot \frac{\Sigma(a^2)}{n},$$

$$\therefore r_{(xa)(ya)} = \frac{\Sigma(xy)\frac{\Sigma(a^2)}{n}}{\sqrt{\Sigma(x^2)\frac{\Sigma(a^2)}{n} \cdot \Sigma(y^2)\frac{\Sigma(a^2)}{n}}}$$

$$= \frac{\Sigma(xy)}{\sqrt{\Sigma(x^2)\Sigma(y^2)}}$$

$$= r_{xy}.$$

11. Proof that if the correlation between any two qualities is due to common elements which are common to both *by chance*, then $R = r$.

(Professor Spearman has kindly undertaken to supply this proof later.)

NOTE.—re *Statistical Treatment of Psychological Data.*

In the use of statistics for psychological problems of such a type as the present, it is necessary to estimate the importance of

1. The choice between the product-moment formula (no. (III)) and that for 'ranks' (no. (IV)).

2. The choice between using or neglecting the correction for the formula for 'ranks' (no. (IV))... $r = \sin\left(\frac{\pi}{6}r'\right)$.

3. The choice between either no. (III) or no. (IV) and Spearman's 'Footrule' (no. (V)), which has been severely attacked in one quarter mainly because it is (what it claims to be) an approximation.

Hot battles are being waged around these topics, and for accuracy it is quite necessary that the relative values of the alternatives should be appreciated. But for much psychological work—including many

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parts of the present research—in which, having obtained the coefficients *by any of these methods*, the conclusions can only be drawn from broad groupings of the results, it seems futile to concern ourselves with them. None of the differences of method involve differences in the results of more than ·03 or ·04 in a coefficient!—and it would be a very unconvincing argument which, in the psychological interpretation of the figures, was based upon even two or three times this amount.

The writer has endeavoured to use, throughout this research, the most accredited refinements on the mathematical side; but if he had to do further similar work, he would use several approximations (the 'Footrule' among them) and thus save many hours of laborious calculation. We do not lose anything by neglecting inches when measuring the distance between cities.



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# APPENDIX II

## A SELECTION FROM THE REPORTS OF THE OBSERVERS AS TO WHAT THEY UNDERSTOOD BY THE TERMS USED IN THE SCHEDULES, AND WHAT GUIDED THEM IN MARKING THEIR SUBJECTS.

1. *General tendency to be cheerful* (*as opposed to being depressed and low-spirited*).

(*a*) 'Did he often or rarely smile? how he met failure and success.' (*b*) 'A tendency to look at the bright side of things habitually.' (*c*) 'Always on the alert to find something over which he and his companions may laugh heartily.' (*d*) 'Disposed to see the bright side of things, always happy.' (*e*) 'Cheerfulness in ordinary affairs, not under any special circumstances.' (*f*) 'To see humour wherever possible.' (*g*) 'Cheerful under all conditions, not disturbed nor worried by reverses, but ready to take things as they came.' (*h*) 'Always looks on the bright side, even in darkest moments there is always a ray of hope which will soon make itself evident in the words and actions of a person who is cheerfully disposed.'

2. *Tendency to quick oscillation between cheerfulness and depression* (*as opposed to permanence of mood*).

(*a*) 'Tendency of the individual to change according to circumstances from morbidness to cheerfulness. (*b*) 'Always in the depths or the clouds, usually with very brief intervals.' (*c*) 'Easily taken from one mood to the other.' (*d*) 'One who could be both cheerful and depressed in a very short space of time.' (*e*) 'Unduly affected by circumstances.' (*f*) 'One moment bright and cheerful, at the next moment quite "down".' (*g*) 'Readiness with which certain subjects would break apart from the serious or merry pursuits of their fellows, and become exceptional by submission to a personal mood which would be contrary to the general demeanour.' (*h*) 'One moment very jolly, the next full of sorrow.'

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3. *Occasional liability to extreme depression.*

(*a*) 'Were there occasions on which the individual took a dejected view of life?' (*b*) '"The extreme hump" on occasion.' (*c*) 'Often worried a good deal.' (*d*) 'Sometimes extremely difficult to cheer up.' (*e*) 'Depression without any evident cause.' (*f*) 'Liability to have fits during which everything looks black.' (*g*) 'While the mood lasted, obsessed with their trouble.' (*h*) 'Tendency to become low-spirited, pessimistic, dull or languid, and out of harmony with the general environment at times.' (*i*) 'Eager to fasten on a grievance, real or imaginary, and make the most of it.'

4. *Readiness to become angry.*

(*a*) 'Could he control himself, or did he tend to become angry at the least provocation?' (*b*) 'Tendency to "flare up" suddenly on slight provocation.' (*c*) 'Easily irritated.' (*d*) 'Fly into a passion for a trivial reason.' (*e*) 'Passions aroused easily in ordinary intercourse.' (*f*) 'Trifling things make them angry.' (*g*) 'Tendency to become "ruffled" on the slightest provocation.' (*h*) 'Degree to which a person *outwardly* exhibits signs of aversion to some object or circumstance.' (*i*) 'Anger on the least provocation.'

5. *Readiness to recover from anger.*

(*a*) 'Having lost his temper how soon could he recover his "normal" self?' (*b*) 'Blaze up suddenly and are as suddenly mollified.' (*c*) 'Ill-governed temper.' (*d*) 'Quickness or otherwise with which an injury was forgotten.' (*e*) 'When the display of displeasure is over the man is again quite friendly and ready to smile at what lately raised a frown.' (*f*) 'To turn into a smooth and composed being, as readily as to turn into an angry being.' (*g*) 'Period of time elapsing between the states of anger and composure.'

6. *Occasional liability to extreme anger.*

(*a*) 'Occasional loss of absolute control over himself.' (*b*) 'Subject to almost uncontrollable fits of anger occasionally.' (*c*) 'Easily angered.' (*d*) 'Very hot-tempered.' (*e*) 'A personal affront will evoke a rapid torrent of angry words.' (*f*) 'Their anger reaches a climax and controls the man.'

7. *Degree of aesthetic feeling (love of the beautiful for its own sake).*

(*a*) 'If he loves Art and all that is clean and pure for its own sake, then he has the true aesthetic feeling.' (*b*) 'Admiration for a poem, picture, book, etc., for its inherent beauty.' (*c*) 'Appreciative enjoyment of the beautiful as shown in poetry, art, etc.' (*d*) 'Desire to perceive beauty in all its forms because of the pleasure brought by

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the perception.' (*e*) 'Love of the beautiful because it appealed to their finer nature and to their finer emotions.' (*f*) 'Way in which subject would involuntarily attend to or ignore things which are calculated to appeal to the aesthetic feelings.'

8. *Degree of sense of humour.*

(*a*) 'Quick in their apprehension of the humorous.' (*b*) 'Readiness to make jokes.' (*c*) 'Quickness to see a joke.' (*d*) 'Ease with which he saw the funny side of things.' (*e*) 'Readiness to see the funny side of things.' (*f*) 'Marks assigned according to whether or no a man showed ready appreciation of the ridiculous and the incongruous, as well as a comprehension of the finer degrees of satire, irony or sarcasm.' (*g*) 'Able to appreciate a joke and see its meaning at once.' (*h*) 'Power of appreciating a joke and of making one.'

9. *Desire to excel at performances (whether of work, play, or otherwise) in which the person has his chief interests.*

(*a*) 'Did he "show off" or "play to the gallery"?' (*b*) 'Desire to do well for the sake of excelling *others*, not so much for the work's sake.' (*c*) 'The keenness with which he followed his favourite work.' (*d*) 'Desire to beat all rivals.' (*e*) 'The "plus" characters were patently anxious to do better than their fellows, they believed in their own powers and made no secret of it.' (*f*) 'The wish to distinguish oneself, not ostentatiously, but in order to give oneself satisfaction.'

10. *Desire to impose his own will on other people (as opposed to tolerance).*

(*a*) 'Desire to be a leader.' (*b*) 'Wanted their own way and sulked when they did not get it.' (*c*) 'Degree to which he desired to override the opinions of others, and press forward his own.' (*d*) 'Desire to have his own way.' (*e*) 'Dogmatic, and inclined to be intolerant of the views of others.' (*f*) 'No wish to hear both sides.' (*g*) 'Blindly believing that his ideas are the only correct ones.' (*h*) 'An autocratic attitude towards his fellows.'

11. *Eagerness for admiration.*

(*a*) 'Acting or speaking, not naturally, but to gain the applause of his fellow-men.' (*b*) 'Playing to the gallery.' (*c*) 'Desire to be appreciated, and tendency to talk of their own "prowess".' (*d*) 'Long speeches to win approval.' (*e*) 'Conceit.' (*f*) 'Extent to which a subject would go in order to display his talents, and thereby gain the applause of others.' (*g*) 'Enjoys being in the "limelight".' (*h*) 'Will set aside principles for the sake of admiration.'

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12. *Belief in his own powers.*

(*a*) 'Self-confident.' (*b*) 'Degree of diffidence with regard to the work.' (*c*) 'Boastful.' (*d*) 'Plenty of self-confidence.' (*e*) 'Believes himself equal to any task.' (*f*) 'Spoke of superiority to others.'

13. *Esteem of himself as a whole.*

(*a*) 'Feeling of satisfaction with himself as a member of society from the point of view of general ability to "cut a figure".' (*b*) 'Decidedly the reverse of modest and self-depreciatory.' (*c*) 'Boastful of capability to overcome practically all difficulties.' (*d*) 'The general estimate or summing up of himself by himself.' (*e*) 'This includes belief in one's own powers and a considerable satisfaction with everything belonging to or connected with one, at the same time this feeling caused the owners to regard others in a pitying manner.' (*f*) 'Thinking oneself above criticism.' (*g*) 'Subject's good opinion of himself, especially of his personal actions.'

14. *Offensive manifestation of this self-esteem* (*superciliousness*).

(*a*) 'No. 13 carried to excess.' (*b*) 'This follows from the last (13) in a way, though a man might think very highly of himself without offensive manifestation.' (*c*) '13 pushed to excess.' (*d*) 'Overdoing No. 13.' (*e*) 'Looking down upon others.' (*f*) 'The + characters did not disguise the low esteem in which they held such opinions as did not fit in with their own ideas.' (*g*) 'Looked at times upon everyone else with contempt.' (*h*) 'Subject's over-bearing manner, due to too much self-confidence, and too great an opinion of himself.' (*i*) 'A person possessing this quality in a high degree always carries an air of superiority and seizes every opportunity of giving vent to his high opinion of himself.' (*j*) 'Always talking of themselves—always imposing their esteem of themselves on other people unwilling to hear it.'

15. *Fondness for large social gatherings.*

(*a*) 'Tendency of the individual to attend the larger social gatherings of the College.' (*b*) 'Regular and punctual at smoking concerts and other assemblies.' (*c*) 'Always anxious to get a number round him in all his pleasures, and often organising pleasure-trips with his friends.' (*d*) 'Always at ease with a large company, ready to sing, play, or do anything.' (*e*) 'Passive agents rather than themselves contributors to the general enjoyment.' (*f*) 'A desire to gather together in a jovial crowd.' (*g*) 'Degree to which he manifests the "Social Instinct".' (*h*) 'Desire to be with the crowd, as opposed to No. 16, and also as opposed to desire for solitude.'

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16. *Fondness for small circle of intimate friends.*

(*a*) 'Fond of associating with one or two inseparable friends.' (*b*) 'One who only feels at home with a few special intimates.' (*c*) 'Here the reverse to No. 15 holds; this would involve the active participation of each member in the activity of the circle.' (*d*) 'The antithesis of No. 15.' (*e*) 'Constant to a few friends.' (*f*) 'Does not make friends readily.' (*g*) 'Desire to possess a small number of intimate friends and to spend all spare time with them; as opposed to No. 15; and also to solitude.'

17. *Impulsive kindness (to be distinguished from No.* 18).

(*a*) 'Tendency to do a kindness on the spur of the moment.' (*b*) 'Good-hearted enough, but in a spasmodic way.' (*c*) 'Being kind naturally, without a previous thought.' (*d*) 'Sudden acts of kindness inspired by special circumstances.' (*e*) 'Tendency to be carried away to kind actions by the emotions.' (*f*) 'Ready to do a kind act on the spur of the moment, but did not go out of their way to do a kindness, nor do anything which would be inconvenient to themselves.' (*g*) 'Generally speaking very cold to the majority of men, but on occasion as warm-hearted as could be.' (*h*) 'Instinct, rather than abstract ethical considerations, is the motive.' (*i*) 'Kind actions or words depending on his own mood at the time.'

18. *Tendency to do kindnesses on principle.*

(*a*) 'Kind because they felt it their duty to be so.' (*b*) 'Kind because it seemed the proper thing to do.' (*c*) 'Kind after general consideration and conflict between selfish and unselfish promptings.' (*d*) 'Readiness to help anyone, whether friend or no, at all times.' (*e*) 'People marked + would anticipate one's needs and put themselves to much inconvenience to oblige or help anyone else, whomsoever it might be.' (*f*) 'Kindness as a natural disposition.' (*g*) 'Tendency to act kindly on every occasion because it was considered to be the correct thing to do, or because the subject had developed a habit of kindly acts and behaviour.' (*h*) 'Kindness which is "virtue for virtue's sake".' (*i*) 'Habitual kindness based upon a conscious moral ideal.'

19. *Degree of corporate spirit (in whatever body interest is taken, e.g. college, school, country, native place, etc.).*

(*a*) 'How does he work when one of many working for a definite end?' (*b*) '"Playing for the side" as opposed to "fighting for their own hand".' (*c*) 'Sinking oneself for the good of the team.' (*d*) 'Love of working together, all aiming for one end.' (*e*) 'Degree to which "Esprit de corps" would control his ordinary acts.' (*f*) 'Extent to which

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subjects realised truth of maxim "Union is strength".' (*g*) 'Extent of the spirit which unites them to college, etc. and will not let them leave it or forsake it for others.'

20. *Trustworthiness* (*keeping his word or engagement, performing his believed duty*).

(*a*) 'The + men are the men I would trust and believe.' (*b*) 'One who can be relied upon always.' (*c*) 'The extent to which he tried to do exactly what he knew others expected from him by his words or promises.' (*d*) 'The straightforward manliness and the religious convictions of the + characters would make it impossible for them to fail in their pledge or duty.' (*e*) 'Understood as to whether the subject could be depended upon at all times when once he had given his word or promise, and whether he would carry out at all costs, if possible, what he is in honour bound to perform.' (*f*) 'Regarding a promise as a duty.' (*g*) 'Regarding a promise as binding.'

21. *Conscientiousness* (*keenness of interest in the goodness and wickedness of actions*).

(*a*) 'The amount of thought given to his actions as to their goodness or wickedness.' (*b*) 'Care taken by subjects to be fully conscious of the morality of their deeds; an habitual power of discrimination, telling them which was the right thing to do.' (*c*) 'Honourable in work and play.' (*d*) 'One who carefully discriminates between right and wrong.' (*e*) 'Acts mainly on intellectual consideration of goodness or wickedness of actions.' (*f*) 'The tendency to weigh an action as to whether it is good or bad, apart from its results.' (*g*) 'Interested in the morality of the actions of themselves and others.' (*h*) 'Quick at apprehending the good in everything, in literature, art and actions.' (*i*) 'Pleasure at doing and seeing done good works and hearing good words.'

22. *Interest in religious beliefs and ceremonies* (*regardless of 'denomination'*).

(*a*) 'Difficult to judge, the interest may be antiquarian or something like that, but the + men showed most interest and the − men little or none.' (*b*) 'One who is really religious and sees the significance of ceremonies.' (*c*) 'The interest is shown by a readiness and a desire to talk and discuss religious matters with others who are interested—it must be clearly understood that they would not force their conversation on any, and would talk only with such as would discuss the matter seriously and reverently.' (*d*) 'Love of new theories and arguments for and against.' (*e*) 'Sincerity of belief in religious creeds, particularly



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the one the subjects adopted for themselves.' (*f*) 'This was the most difficult quality to assess, owing to the lack of opportunity of forming a judgment based upon wide observations; the extent to which he devotes himself to religious problems, and his attachments to the outward ceremonies of his beliefs.'

23. *Readiness to accept the sentiments of his associates.*

(*a*) 'The steadfastness with which he clung to his own beliefs and sentiments.' (*b*) 'The + men usually "swam with the stream" and were always with the majority; the − men had opinions of their own and stuck to their guns.' (*c*) 'Agreeing as far as he can; seeking points of agreement rather than difference.' (*d*) 'The lack of any signs of marked contradiction in ordinary conversation.' (*e*) 'Readiness to agree with the sentiments of his fellows, and not to argue about or to criticise them.' (*f*) 'This readiness was due to mental apathy or, as in the case of B—, to modesty and a desire to give the opinions of others due regard; on the other hand, the disinclination to give way to others was due to self-assertion and a good conceit of themselves or, as in the case of T—, to firm convictions which he could ably support in arguments.' (*g*) 'Tendency to be carried away by the views of others and to adopt them as their own.' (*h*) 'The readiness with which he submerges his own individuality and is subject to the domination of the opinions, feelings, etc. of his associates, and not able to form an independent judgment, often because he is not capable of doing it or because of lack of confidence in his own powers.'

24. *Desire to be liked by his associates.*

(*a*) 'Desire to be popular.' (*b*) '+ men anxious to be popular, − men not so anxious for popularity as for being right.' (*c*) 'Rather a marked selfish desire to be counted a good fellow, far beyond the usual desire possessed to some extent by everyone.' (*d*) 'Was the subject ready to do things for another? did he fall foul of anybody, or was he ready to offend them?' (*e*) 'Wish to be friends with all—would often submit rather than cause a slight disagreement.' (*f*) 'Judged according to the way in which they tried to please and help their friends.' (*g*) 'Desire for popularity.'

25. *Wideness of his influence* (*i.e. the extent to which he makes his influence felt among any of his fellows whenever he speaks or acts*).

(*a*) 'How is he regarded by his fellow-students; how did they accept his conclusions and judgments?' (*b*) '+ men listened to respectfully and had strong influence, − men no influence whatever.' (*c*) 'Personal magnetism.' (*d*) 'In general, unconsciously only.'

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(*e*) 'Were the other men ready to listen to him?' (*f*) 'Personality in word and action; when they spoke the words seemed to go home.' (*g*) 'Owing to their good temper and friendliness the + characters received consideration if they expressed an opinion.' (*h*) 'The manner in which a man's decision or action would influence the decisions and actions of his fellows.' (*i*) 'The effect his conduct has on his friends; the amount to which their actions are altered through contact with him.' (*j*) 'Influence over all or any with whom he comes in contact; eagerness with which people stop what they are doing and listen when he begins to speak.'

26. *Intensity of his influence on his special intimates.*

(*a*) 'Was his word law among his associates?' (*b*) 'This is slightly different from the last (25) and you will notice a different classification; in this case the + man seemed to have strong influence on his special intimates.' (*c*) 'A leader among his associates, though not the most accomplished.' (*d*) 'One who is a leader of a small "clique".' (*e*) 'Also merely an unconscious influence.' (*f*) 'A leader among his two or three friends.' (*g*) 'The *profoundness* of the impression he makes on the minds of his fellows is lasting.'

27. *Degree of 'tact' in getting on with people.*

(*a*) 'The ability of the individual to get on with others, and the means by which he got out of awkward corners.' (*b*) 'The + men avoided the difficulties into which others managed to get.' (*c*) 'Pleasant manner and obliging attitude.' (*d*) 'No. 23 + diplomacy.' (*e*) 'Rather a planned way of dealing with people than a natural gift.' (*f*) 'Capability to smooth people down, by his personality, manner, bearing, etc.' (*g*) 'The + characters understood and were considerate of the feelings of others; they were good-tempered and did not make blundering remarks or hurtful speeches, neither did they exhibit any "superiority".' (*h*) 'Amount of natural ability in dealing with people.' (*i*) 'Could "manage" people, chiefly colleagues, by observing their characteristics.' (*j*) 'Diplomatic way of winning the favour of others.'

28. *Extent of mental work bestowed in usual studies.*

(*a*) 'The thoroughness with which he attended to his work.' (*b*) 'I have tried to differentiate the men according to the *work* which I thought they did, not to judge them by their success or otherwise.' (*c*) 'Assiduous workers.' (*d*) 'One who works hard at his studies, but is not necessarily naturally brilliant.' (*e*) 'Reckoned in amount of actual energy, not in results of work, or quickness of work.' (*f*) 'Extent of time spent and interest taken in the usual studies.' (*g*) 'The + men

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worked hard and conscientiously; their work was well prepared and evidenced much thought and reading.' (*h*) 'The + men possessed power of concentration—difficulties did not throw them off a task.' (*i*) 'The + men, even when they failed, seemed to have been thoughtful.' (*j*) 'Amount of actual thought on work, as opposed to "parrot fashion" learning.'

29. *Extent of mental work bestowed on pleasures (games, etc.).*

(*a*) 'How did he play, with his "head" or "body"?' (*b*) 'The + men worked hard at their play, but the − men may have had pleasures at home, say, of the work given to which I had no opportunity of judging.' (*c*) 'Using his head in sport, and his readiness to discuss points of tactics in football, etc.' (*d*) 'Reckoned in amount of energy spent, not in results.' (*e*) 'The extent to which the men thought over and planned their pleasures and games.' (*f*) 'Thought in order to insure proper and efficient pleasure.' (*g*) 'Taking an interest in games—following the big teams, etc.' (*h*) 'Understood to mean amount of mental energy employed in consideration of pleasurable pursuits.' (*i*) 'The extent to which he takes up games seriously, as opposed to joining in a game merely for the sake of playing. Has Mrs Battle's "Rigour of the game" ('Mrs Battle on Whist,' *Essays of Elia*, C. Lamb).'

30. *Degree of bodily activity during 'business' hours.*

(*a*) 'Restlessness while attending to his duties.' (*b*) 'Love of physical movement, not much repressed in lecture time.' (*c*) 'Amount of actual physical activity evident to others.' (*d*) 'The restlessness of the subject, either in doing his work, or not doing it, as the case may be.' (*e*) 'General "looking-alive" appearance during whole period of work.' (*f*) 'The energy with which he attacks his work.' (*g*) 'Activity, even though that activity was not required, e.g. scribbling on a piece of paper when attention to a lecture was required. The − men displayed more the air of boredom.' (*h*) 'The extent to which the body moves while at business, as opposed to sitting still and keeping all thought on business.'

31. *Degree of bodily activity in pursuit of pleasures (games, etc.).*

(*a*) 'How far would he put himself out (physically) in joining in a game?' (*b*) '+ men more active, − men less so.' (*c*) 'Appeared to be all alive when pleasure-seeking.' (*d*) 'Hard physical work at games.' (*e*) 'Amount of actual physical energy evident to others.' (*f*) 'Readiness with which men would undertake bodily fatigue in pursuit of their pleasures.' (*g*) 'The + men were never happy unless they were rushing about, either on playing fields, in the slips, or gym.

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The − men always quiet, took no interest in sport, and therefore no bodily activity was necessary.' (*h*) 'The + men went in for out-door sports and did not tire of them. They were "out to win" every game.' (*i*) 'The extent to which he "throws himself into" a game.'

32. *Degree in which he works with distant objects in view (as opposed to 'living from hand to mouth').*

(*a*) 'Did he always live for the present, or did the future ever trouble him, with regard to (i) his pleasures, (ii) his studies or duties?' (*b*) 'The + men showed forethought, the − men were happy-go-lucky.' (*c*) 'One who lives and works now in order to enjoy results in the future.' (*d*) 'The capacity for acting in the present strongly guided by what may happen in the future, however distant.' (*e*) 'The + men worked hard to educate themselves or to fit themselves for their career, as opposed to working to get top in an examination.' (*f*) 'The + men work looking towards the future; in fact T—'s religious convictions cause him to work wholly and entirely to fit himself for the life after this.' (*g*) 'The extent to which he works as a means to an end.' (*h*) 'The extent to which he looks forward to and prepares for the future, with a view to improving his lot.'

33. *Tendency not to abandon tasks in the face of obstacles.*

(*a*) 'How did he face difficulties in any direction?' (*b*) 'The − men seemed to possess very little determination or initiative. How work bored them and they frequently gave up tasks because they involved some difficulties.' (*c*) 'Perseverance.' (*d*) 'Obstacles meaning real impediments or difficulties, mainly exterior.' (*e*) 'The + men possess tenacity of purpose, and keep to the task till the difficulty is overcome.' (*f*) 'The − men did not possess the power of concentrated attention.' (*g*) 'Almost the same as 32. The − men lacked doggedness.' (*h*) 'The quality known as "doggedness".'

34. *Tendency (not) to abandon tasks from mere changeability.*

(*a*) 'Want of persistence in his efforts.' (*b*) 'One who would work well until some other influence got to work.' (*c*) 'The + men ready to engage upon novel tasks, and abandon them when the novelty has worn off.' (*d*) 'Understood to mean tendency to give up a task, even when nothing interferes with its progress, just because the subject's mind flits here and there, having many interests of a superficial kind.' (*e*) 'Attempting many tasks, but accomplishing little.' (*f*) 'Nature makes them always seek something fresh. If a task takes long to perform, even if easy, they will give it up for the sake of a change.'

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35. *Quickness of apprehension.*

(*a*) 'Quickness of grasping a truth or a problem.' (*b*) 'The + men saw the point at once.' (*c*) 'Alacrity in understanding new material.' (*d*) 'Understanding at once—judged by his readiness with a fresh argument in a discussion.' (*e*) 'Speed with which a subject can grasp a new idea and use it.' (*f*) 'They see the point.' (*g*) 'Taking in circumstances at a glance and judging accordingly.' (*h*) 'A quick recognition of the true significance of things.' (*i*) 'Quick-witted.'

36. *Profoundness of apprehension.*

(*a*) 'The subjects grasp not only the new truth or problem, but its relationship to other truths and problems at the same time.' (*b*) 'The + men *perhaps* did not see the point quite so soon as those in 35, but they grasped it more thoroughly, I think.' (*c*) 'Comprehensive insight, judged by the detection of motives and grasp of a situation.' (*d*) 'The extent to which he weighs considerations. Much independence of thought would be involved.' (*e*) 'The grasping an idea fully, turning it over, and viewing it from every point of view.' (*f*) 'Having grasped a point, the + men see its bearing on the subject and associate it readily with other information on the same subject. They realise its relative importance.' (*g*) 'The + men did not grasp the facts quite so quickly, but when they did they saw more clearly and could judge better.' (*h*) 'The + men always regard things in several different aspects, and are not ready to come to definite conclusions and to assert opinions.'

37. *Soundness of common-sense.*

(*a*) 'When he spoke or acted, did he do so in a sensible way?' (*b*) 'I would ask, and value, the opinion of the + men. That of the − men I would neither ask for, nor value it if I got it unasked.' (*c*) 'Knowledge how to act under trying circumstances.' (*d*) 'Realising results of actions and proceeding accordingly.' (*e*) 'An all-round grasp of any situation, forgetting no dominant factor.' (*f*) 'General reasonableness.' (*g*) 'The degree to which he possesses a good, sound, reliable, and balanced judgment.' (*h*) 'Advice and assistance always practical and to be relied upon.'

38. *Originality of ideas.*

(*a*) 'The + men had many "happy thoughts," but I estimated the *originality* of the ideas, not their *value*.' (*b*) 'The + men could suggest solutions to all kinds of difficulties.' (*c*) 'One who thinks for himself.' (*d*) 'The number of new ideas, strange fancies, novel aspects of situations, which occurred to him, and the speed with which they came into his mind.' (*e*) 'Having ideas different from those of others, yet not

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fantastic, ridiculous ones.' (*f*) 'The man with original ideas is able to suggest ways and means while others are still racking their brains. The ideas too are new; they are his own—they apply previous knowledge certainly, but in fresh combinations, adapted to new circumstances.' (*g*) 'The + men always depend upon their own minds to cope with a situation, instead of borrowing ideas of others.'

39. *Pure-mindedness.*

(*a*) 'Possessing a high degree of morality.' (*b*) 'The readiness or otherwise shown by men to tell immoral tales, or to gather round when they are being told.' (*c*) 'I have never heard a wrong word from those marked +. They avoid the company of those who are not so careful, and have always shown disgust at anything savouring of impurity.' (*d*) 'The − men would listen to improper stories and tell others; + men would express their disgust.' (*e*) 'The + men deprecate immoral wit and thought, and seek entertainment in healthier ways.' (*f*) 'The extent to which he is successful in (apparently) banishing carnal thoughts from his mind.'

28*a*. *Power of getting through mental work rapidly.*

(*a*) 'Mental alertness.' (*b*) 'The + men are quick at any mental exercise.' (*c*) 'Quickness to learn.' (*d*) 'Quickness of apprehension, rather than thoroughness.' (*e*) 'The + men understand a thing rapidly and with apparently little mental effort, possibly due to the readiness with which they associate the new with the old.' (*f*) 'Power of thinking rapidly and working mental problems expeditiously.' (*g*) 'The readiness with which his mind absorbs ideas. Another man might understand a thing equally well, but it takes him a much longer time.'

42. *'General' estimate of good character.*

(*a*) 'A kind of general sum up.' (*b*) 'A man who is straight, and fearless, and dependable.' (*c*) 'A general impression, which in prominent cases (+ and −) would be subjected to a fair amount of consideration and weighing up.' (*d*) 'The man who in my opinion had the most harmonious combination of the various virtues—truth, honour, straightforwardness, kindness, and also ability, both mental and physical.' (*e*) 'Estimate was based on personal integrity.' (*f*) 'The qualities and habits which go to make a true man.' (*g*) 'General impression of subject's worth as a man, without reference to special qualities.' (*h*) 'Accumulated impressions of the subject with reference to my ideas of good and bad.'

47. *Degree of strength of will.*

(*a*) 'Quiet determination, persisting in his own view in spite of

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opposition.' (*b*) 'Tenacity with which the subject holds to his beliefs, etc.' (*c*) 'I regard their will as that part of themselves which carries out the dictates of conscience, as opposed to, say, animal appetites.' (*d*) 'Consideration was given to ability to control anger, spite, and jealousy.' (*e*) 'Great determination.' (*f*) 'Purposefulness.' (*g*) 'Not easily influenced, nor turned aside from their purpose.' (*h*) 'Power of resisting temptation.' (*i*) 'Tenacity or otherwise, displayed by the subject in sticking to a certain course of action once it has been decided upon.' (*j*) 'Not to be turned aside by argument or persuasion, from a course to which he has made up his mind to adhere.'

48. *Degree of excitability, as opposed to being phlegmatic.*

(*a*) 'All nerves.' (*b*) 'The + men readily aroused to heated argument.' (*c*) 'The + men aroused to great warmth by expression of views opposed to their own.' (*d*) '(For me) almost akin to enthusiasm, although it differs in so far as I take enthusiasm to be a continuous force, excitability as momentary. Excitability is a spark of enthusiasm.' (*e*) 'The degree in which trivial occurrences have the power to disturb the calm of the subject.' (*f*) 'A tendency to show outward signs of enthusiasm over any special hobby.'

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